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STUDIES ON THE CIRRIPEDIA ACROTHORACICA

I. BIOLOGY AND EXTERNAL MORPHOLOGY OF THE FEMALE OF *BERNDTIA PURPUREA* UTINOMI[1]

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With Plates I–II and 11 Text-figures

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Introduction

About twenty years ago, while examining reef corals occurring in Tanabe Bay on the Pacific coast of southern Japan, I happened to find an Acrothoracian cirriped plentifully boring into the two kinds of reef corals, and reported its find, only mentioning about its close affinity with *Lithoglyptes indicus* Aurivillius which was hitherto known as an Acrothoracican boring in corals and molluscan shells, though characterized by some remarkable peculiarities (Hiro, 1937). Since then I have continued the studies on this Acrothoracican, though so much interrupted by my military service of three years during the war, and, as a matter of fact, major part

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of them have hitherto been finished in 1943. After the war, in a short preliminary note (UTINOMI, 1950a, c), I described it for the first time under the name *Berndtia purpurea* n. gen. et sp. In addition to this, another new Acrothoracican *Balanodytes taiwanus* n. gen. et sp. from Taiwan was also described (UTINOMI, 1950b, c).

In a series under the head title I will give hereafter the detailed descriptions of these two forms, and additionally intend to contribute some new informations regarding the comparative anatomy, homology and classification in the Acrothoracica. The present paper given here is the first part of this series dealing with the biology and external morphology of the female of *Berndtia purpurea.*

Acknowledgment

Before proceeding further I wish to acknowledge my indebtedness to many persons who have supported the present investigation in various ways. In particular, I am greatly indebted to the late Yanosuke SAIKA, who was an eminent collector and skipper served over a period of thirty years at our Seto Laboratory and died on February 10th, 1957, aged 69, for assistance at the field works and in collecting the material by diving. I wish to express my sincere thanks to Prof. Emeritus Taku KOMAI of Kyoto University for his kind guidance and encouragement throughout the work. Further thanks should be extended to Prof. Emeritus Hisakatsu YABE, the late Dr. Toshio SUGIYAMA and Dr. Motoki EGUCHI for allowing me to examine the vast collections of reef corals deposited in the Museum of the Paleontological and Geological Institute of Tôhoku University at Sendai.

Material and Method

The material of the present Acrothoracican *Berndtia purpurea* was obtained in the littoral of Tanabe Bay at any occasion throughout this work.

For systematic purposes, some specimens were selected as type specimens (Type No. 53) to be preserved in the collections of the Seto Marine Biological Laboratory. Additional specimens (Rare Nos. 94 and 103) are also preserved as they are associated with their host corals.

Living animals were observed in the sea, or, after transferred from the natural habitat, in the aquaria without removing from the coral colony. Observations on the cirral movement and the larval development were made by placing the infected coral stock in a large flat-bottomed dish containing sea water. Dissection of living and fixed materials was made under the binocular microscope by means of fine and sharp needles. For microscopical study of the detailed internal structures which will be dealt with in Part II, serial sections were made, and some drawings in this paper were made by using the method of projection reconstruction.

All the materials for microscopical examination were fixed with 3% formalin, Bouin's solution or Rabl's picro-sublimate solution all of which brought good results in the same way. The microtome sections were stained with the usual methods of Delafield's or Ehrlich's haematoxyline-eosin and boraxcarmin-bleu de Lyon, and also, for the male, with boraxcarmin, acetocarmin or methylen-blue alone.

Natural Habitat and Distribution

Natural Habitat

All the species of the Acrothoracica are known to live buried in the calcareous matter such as certain chitons, gastropod shells, barnacle plates and corals. The present Acrothoracican is found in abundance, invariably bored into the living colonies of the two kinds of corals, *Leptastrea purpurea* (DANA) and *Psammocora profundacella* GARDINER, both common on submerged cliffs or reefs just below the lowest tide level around the Laboratory. The frequency of occurrence seems to be greater in *Psammocora* than in *Leptastrea*, probably because of the smaller calices and thinner coenosarc covering the hard skeleton. In both corals it diminishes as the habitat becomes deeper. As an example of greatest infection I have met with, about 150 individuals were found in an area of a square 5 centimeters on a flat surface of *Psammocora profundacella* colony.

In the neighboring places some different corals are usually found in association with them. However, curiously enough there is no trace of infection of the Acrothoracican. This fact shows that the association between Acrothoracican and corals aforesaid is by no means incidental but obligatory for survival in the former. Apparently the permanent occurrence on the coral is not harmful to the life of the latter, but their heavy infection seems to be subject to more or less modification of calices around the infected part in size or manner of growth.

In an example of *Psammocora* heavily infected by this Acrothoracican, the calices are usually smaller with less numerous septa and separated by broader interspaces of coenosarc than in the uninjured specimen. Such specimen, as far as the structure of calices is concerned, is apparently a separate species (cf. YABE et al., 1936, p. 61, pl. XLIV, fig. 7 and pl. XLV, fig. 9). In my opinion it may be a deformed specimen of ordinary *P. profundacella* due to the dense infection of Acrothoracicans, especially in view of its rigid host specificity. In fact, I have often observed that the lodgment of other coral-inhabiting barnacles, such as *Creusia* and *Pyrgoma*, is subject to modify the direction of growth of the host coral to some extent accompanying with the repair growth of the latter itself (HIRO, 1938).

The occurrence of *Berndtia purpurea* is readily defined by its peculiar oblong slit of the burrows, as is shown in Plate I. In any colony of the infected corals, the situation of these slits is always confined to the living part of the coral and none is found on the dead part; but if present, they may possibly be those formed before the corals have died. As a rule the slits are situated on the skeletal wall between calices, because the animals settle on the coenosarc between polyps at their early stage of excavation. Therefore, the animals fastened themselves to the coral skeleton are able to excavate downwards and to reach to a full size with the least trouble as the polyps of infected corals grow upwards. As to the function of excavation connected with the larval development, this will be discussed in a later paper.

The slit is oblong in outline and a little more rounded on one end (namely the rostral side of the animal) than on the other (namely the carinal side). It measures about 1 to 3 mm in length and 0.3 to 1.2 mm in width. The edge of the slit is slightly ridged and whitish, and the space in the slit is often filled with calcareous matter which consists of fine granules and silt or detritus, discharged by its own function of excavation and entangled with mucus secreted from the coral. If such slimy calcareous granules are excessively deposited at the slit and cover wholly the opening, it may be dangerous to the enclosed animal. However, the opening of the burrow is incessantly swept by the cirral movement, so that it may not be so dangerous as would be expected.

Distribution

From the above fact that the association of *Berndtia purpurea* with the two particular kinds of corals is very rigid in examples of Tanabe Bay, it is very likely that it may occur more widely in tropical seas.

Fortunately enough, I have had the opportunity of examining the extensive collection of reef corals preserved in the Museum of the Institute of Geology and Paleontology, Tôhoku University at Sendai, through the kindness of the authorities of that Institute in charge of the coral collection. The collection has been gathered from various localities of Japan, Micronesia and other all tropical seas, and based on this collection three monographs with magnificent photographs have been published by that University in 1936, 1941 and 1942 respectively.

On examination I have ascertained again that the infection of *Berndtia purpurea* is strictly confined to the two corals mentioned above. The localities of the examined specimens of corals apparently infected by *Berndtia*, as inferred from the peculiar slits, are given below, with details of registered numbers. Some of them are finely illustrated in the first volume of the aforementioned monographs (YABE, SUGIYAMA and EGUCHI, 1936).

Leptastrea purpurea (DANA)

1) Tanabe Bay, Wakayama-ken, Honsyû. (Reg. No. 40525, etc.)
2) Muroto-zaki, Kôti-ken, Sikoku. (Reg. No. 40770)
3) Suzaki, Kôti-ken, Sikoku.
4) Ôura, Miyazaki-ken, Kyûsyû. (Reg. No. 40773)
5) Konesime, Kagosima-ken, Kyûsyû. (Reg. No. 40775)
6) Naka-kosiki, Kosiki Islands, Kagosima-ken, Kyûsyû. (Reg. No. 48263)
7) Usibuka, Kumamoto-ken, Kyûsyû. (Reg. No. 45147)

8) Hûkikaku, Northernmost end of Taiwan. ? damaged.
9) Helen Reef, Palau Islands, Micronesia.

Psammocora profundacella GARDINER

1) Tanabe Bay, Wakayame-ken, Honsyû. (Reg. No. 36886)
2) Kusimoto, Wakayama-ken, Honsyû. (Reg. No. 40974)
3) Suzaki, Kôti-ken, Sikoku. (Reg. No. 36887)
4) Sarusima, Miyazaki-ken, Kyûsyû. (Reg. No. 36885)
5) Udo, Miyazaki-ken, Kyûsyû. (Reg. No. 40983)

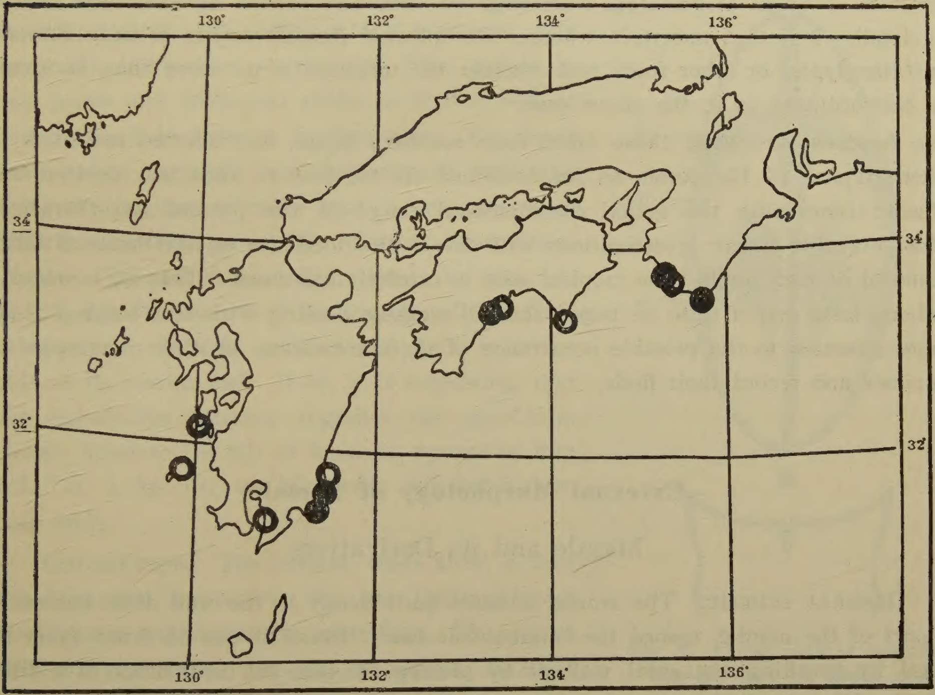


Fig. 1. Distribution of *Berndtia purpurea* on southern coast of Japan, as deduced from the localities of infected reef corals.
○ *Leptastrea purpurea* (DANA).
● *Psammocora profundacella* GARDINER.

From these collecting records of the corals, it may be concluded that the actual center of distribution of *Berndtia purpurea* is the Pacific coast of southern Japan as far north as Tanabe Bay where is the type locality (Fig. 1). It may range further southwards, for it occurs on specimens from Taiwan and Helen Reef of Palau Islands, though being only one case respectively.

Whereas many specimens of the same species and related species belonging to the same genera from Taiwan, Micronesia and Australasian Archipelagoes were likewise examined, I found in vain. And also during a stay at Palau during the year

1934–35 I was engaged in collecting corals and studying the animal associated with them. But I could not find any species of the Acrothoracica on corals.

Nevertheless, there is an only exceptional case which I have encountered in consulting with literature and photographs of reef corals on hand. That is a specimen of Fungiid coral *Podabacia crustacea* (PALLAS) from Singapore which is illustrated in Plate 67, fig. 1 of MA's paper (1937) ; namely, from his photograph we find that the under surface of the colony concerned was heavily infected with an Acrothoracican species, probably referred to this *Berndtia*, or else an unknown species. The original specimen of this coral is probably housed in the Museum of the National Research Institute of China at Nanking, with Reg. No. 469, and cannot be examined directly in detail. It is thus uncertain whether the infected Acrothoracican is truly *Berndtia* or *Lithoglyptes* or other form, and whether the infection is no more than incidental or else ordinary as in the above case.

Anyhow, excepting those taken from southern Japan, the infected materials (or photographs) of the corals so far examined are too poor to allow any positive conclusion concerning the actual distributional range of the present Acrothoracican. Most probably future investigations will reveal new localities or new hosts if larger material of reef corals from tropical seas is carefully examined. This is, however, a tedious task, and it is to be hoped that all workers dealing with reef corals will pay more attention to the possible occurrence of Acrothoracicans or their corresponding burrows and record their finds.

External Morphology of Female

Mantle and its Derivatives

GENERAL SCHEME. The animal adheres quite firmly to the wall of its burrow by a part of the mantle, named the 'attachment-disc'. Hence it can be freed from the coral by breaking the coral wall or by placing the infected coral block in a dilute solution of hydrochloric acid in 70% alcohol for a few days.

The mantle as a whole is shaped like a laterally compressed sac with a slit-like orifice at the tip. It is generally 3–5 mm in length, 2–4 mm in breadth dorsoventrally and 0.8–1.5 mm in thickness, the average size in breadth and thickness being not much different at the upper and lower levels. The rostral side of the mantle, which is shorter than the carinal side, is developed to a horny disc, often lengthened longitudinally. The horny disc occupies a little convex and rather narrow area between the sides of the mantle and a position oblique to the orifice or the surface of the coral ; it is very rare that the disc is widened laterally so as to form such a dorsoventrally compressed plane as in *Trypetesa lampas* (HANCOCK), even if fully developed. The lower end of the disc is, when fully developed, sometimes protuberant like a knob and separated from the carinal side of the mantle by a slight fold, but this may be due to the degree of expansion of the ovarian mass embedded under the disc.

The 'operculum' or mantle-lips formed at the tip of the mantle-sac is, as viewed from above, oblong, with a straight median slit which is the orifice leading to the mantle cavity. Its outline conforms well to the slit of the burrow in which the animal is lodged. The upper surface of the operculum is, when seen from sides, slightly concave above and lies somewhat obliquely to the axis of the mantle. Both the carinal and rostral ends are produced like a canoe-head, and separated by each a deep notch from the mantle itself.

The general outline of the mantle-sac, as mentioned above, closely resembles that of *Lithoglyptes indicus* Aurivillius (1894) which is known only from the Indonesian waters and lives buried in reef corals and molluscan shells, so that I was at first inclined to refer it to the latter. By closer examination especialy on the internal structure, however, it was revealed that it belongs to a different species generically distinct from *Lithoglyptes.* Judging from a figure given by him (cf. Taf. 5, fig. 18), the slit of the burrows of *L. indicus* is apparently sharply pointed and bent to either side at its rostral end. If so, it is surprising that the mantle-lips forming together the operculum closely fitted to the slit of burrows, figured by him (cf. Taf. 5, fig. 10), are bilaterally symmetrical at both ends.

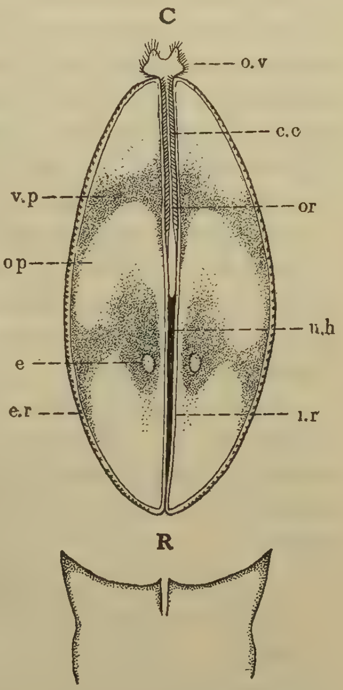


Fig. 2. Upper view of operculum (above) and its cross section through the middle portion (below). Lettering is given at the end of text (p. 26). ×20.

Coloration. The animal, when alive, is very beautiful and impressive for the brilliant color markings on and around the operculum. The typical color of a ripe female has been reproduced in Plate I. The color variation is not pronounced in individuals of all sizes. The operculum is, when seen from above, marked with two pairs of deep violet-blue patterns symmetrically disposed on both lips. The posterior band in each lip perfectly traverses from side to side and its margins are deeply concave anteriorly and posteriorly, while the anterior band is fungoid in outline, leaving a narrow space toward the inner edge of the orifice. In addition there is a golden and refulgent body perceivable through the epidermis in the anterior color marking on both sides, lying close to the inner edge. This is an eye embedded in the connective tissue below the operculum (Fig. 2, *e*). The remaining part of the operculum, except all edges being deep violet-blue, is whitish and tinged with blue dots. In any case these blue dots become indistinct or sparse anteriorly and posteriorly.

The upper part of the lateral sides of the mantle is also tinged with a dull violet-blue to dark purple hue which becomes indistinct downwards. In addition there are three pale bluish or whitish patterns without a definite outline close to the upper margin, the locations of which correspond with those of the same colored areas on the operculum. Further downwards, the mantle-sac is colored yellowish to pinkish yellow or orange, the latter depending upon the age of the animal with growing egg-mass within the mantle-cavity (cf. Plate I, Figs. 1–3).

Internally, the ground color of the body is almost similar to that of the mantle, though much lighter in tone. The upper portion of the head is of a dull violet-blue hue as in the operculum. The posterior portion of the body, especially around the pedicels of terminal cirri, which are protruded out of the orifice, is also the same. The remaining part of the body and the rami of thoracic cirri are uniformly yellowish to pinkish orange. If put the animal into alcohol, these colors would finally fade away, though a violet hue remains for a certain period.

According to AURIVILLIUS (1894), *Lithoglyptes indicus* is whitish, tinged with an indigo-blue color around the edge of the orifice and the neighboring part of the mantle. *L. bicornis* is likewise whitish and furnished with a dark violet stripe below the orifice, whereas *L. ampulla* is whitish at all. Of the other Acrothoracicans, *Cryptophialus minutus* is purple around the orifice and labrum, while *Trypetesa* (=*Alcippe*) *lampas* is colorless or yellowish (DARWIN, 1854) Recently described *T. lateralis* is said to be yellow or orange (TOMLINSON, 1953). Thus the coloration of *Berndtia* is more allied to that of *Lithoglyptes* than to any other. Possibly a similarity in coloration may be regarded as an adaptive significance to the similar habitat.

OPERCULUM. The tip of the flattened mantle-sac, forming the so-called mantle-lips on both sides of the orifice, shows a peculiar feature most like that of *L. indicus*. The lips on both sides are perfectly shut at rest, and thus act as the operculum (Fig. 2, *op*) ; the term is used as homologous with that of ordinary cirripeds, though lacking the calcareous valves. They are very thickened, hardened and chitinous on surface. When seen from above, it is oblong in outline, with a straight median slit leading to the mantle opening. Each lip is thus encircled with an outer convex and an inner straight edge; the former (*e.r*) is sharply ridged and fringed with numerous, close-set chitinous spines, while the latter (*i.r*) is slightly ridged and smooth. The upper surface between the two ridges is somewhat hollowed out and apparently smooth.

ORIFICIAL VELUM. The mantle-lips on both sides are connected at the rostral half of the orifice (*or*) and a little below the inner edge. So there is formed a narrow furrow above the upper surface of the head (*u.h*). At the carinal end of the orifice, the upper edge of the mantle between both lips forms a flexible, thin velum folded outwards, partly closing the orifice. The mantle opening, which leads to the mantle cavity, occupies only the posterior half of the slit between the lips. Thus, the orifice can be opened and shut owing to its being hinged at the rostral or anterior end, consequently when the operculum is closed, the velum is folded outwards. Similar structure has been noticed by DARWIN in *Cryptophialus minutus*, though it is on the contrary folded inwards. This is probably homologous with the membranous lining extending inwards from the base of the carina between the two terga in the rock-burrowing barnacle *Lithotrya* (CANNON, 1947).

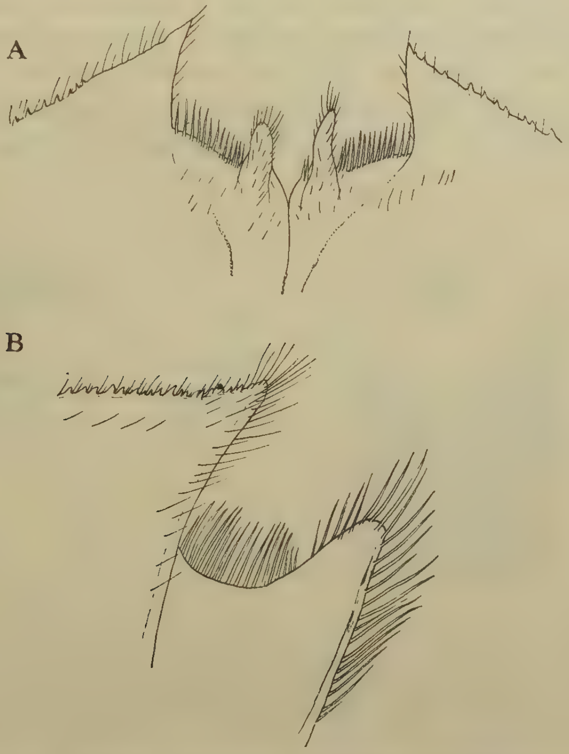


Fig. 3. Orificial velum folded outwards at the carinal end of orifice. A, inner view. B, lateral view. ×60.

This orificial velum (*o.v*) as I here name acts like a hand-bellows each time the operculum opens and closes, and presumably concerned with the boring action which is peculiar to the Acrothoracica and *Lithotrya*. The velum is deeply notched in the middle and on each side formed a prominence thickly covered with coarse hairs. The free edges and outer surface of the velum are likewise coarsely fimbriated (Fig. 3).

COMB-COLLAR. A little way down within the orifice, the true mantle opening is fringed on either side with a comb-like row of flattened setae, which are united at their bases and roundly ended at their free ends. This is named here the 'comb-collar' (Fig. 4, *c.c*) and extends from the orificial velum towards about half of the mantle opening, and the setae become gradually shorter inwards and finally obsolete. These setae are about 0.07–0.09 mm long. The plantation of these setae, as well as coarse hairs at the edge of the orificial velum, may possibly act as a barrier to prevent the ingress of any foreign object into the sac. This comb-collar, which is lacking in ordinary cirripeds except one genus *Ibla*, may be considered as one of the highly specialized structures of the Acrothoracica adapted to boring habit.

Furthermore downwards within the sac, there is a brush of upward-pointing fine hairs (Fig. 4, *hr*) on the inner surface of the mantle on either side. These hairs also may act as accessory barriers to the foreign intruder.

CHITINOUS SPINES. The external surface of the mantle is furnished with many scale-like ornamentations, which become obsolete towards the disc and the lower part.

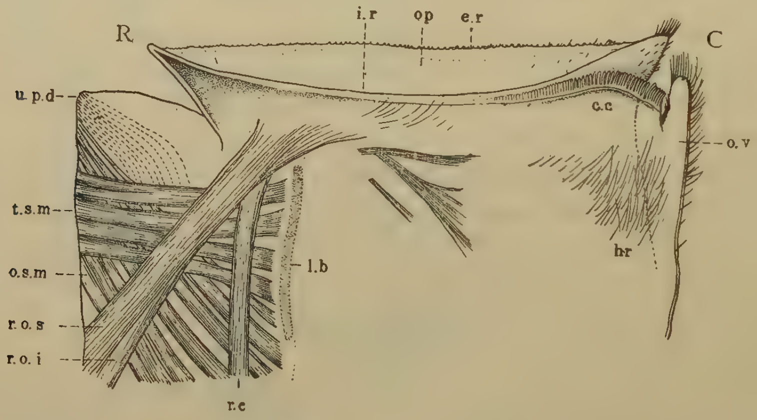


Fig. 4. Upper portion of mantle on the left side, showing the details of operculum and musculature lying towards the attachment-disc, semidiagrammatic, inner view. Lettering as on p. 26. ×20.

Besides, minute chitinous spines (Fig. 5, *sp*) and long hairs (*hr*) are sparsely arranged. These spines are generally directed upwards in the upper part but irregularly in the lower part, and larger towards the operculum, where they measure about 6–15 μ in length. They are simple, bifid or trifid in shape, but not star-headed as in other Acrothoracicans. They are undoubtedly the agents of excavation, so that they may be moulted and worn away together with the external membrane at each exuviation and excavation.

LATERAL BAR. On each side of the external membrane of the mantle towards the rostral side, there is a peculiar chitinous thickening running downwards at a short distance as a slight strip. It is barely discernible even in full-grown specimens, but when distinct, it is tinted yellowish and as long as 0.5 mm. This strip corresponds to the so-called 'lateral bar' or 'horny bar' called by DARWIN (1854) and the

'Verdickungsleiste' called by BERNDT (1907) found in other Acrothoracicans; in *Cryptophialus* it is unusually developed and specialized in structure. Its position coincides with the line along which the body proper within the mantle cavity is connected with the mantle sac (Fig. 4, *l.b*; Fig. 6, *p.l.b*). Internally there is no structure connected with this bar, but it provides the base of attachment for the short transverse muscles (*t.s.m*) extending towards the edge of the upper part of the attachment-disc.

As to its nature, DARWIN and BERNDT suggest that it serves as a fulcrum for the contraction of the longitudinal muscles and supports the orifice by its elasticity towards the base of attachment. This can not be supported at least in the case of *Berndtia*, as will be discussed in more detail later. In short, it apparently serves as a fulcrum by pressing the mantle against its side wall of the own burrow at each excavation or contraction of the whole mantle. A comparable structure has been found in the Ascothoracican genus *Baccalaureus*, as known as 'chitinous ridge' or 'Chitin-Leiste', though in this case it is not situated on the mantle, but on the sides of the anterior part of the body proper (cf. BRATTSTRÖM, 1956).

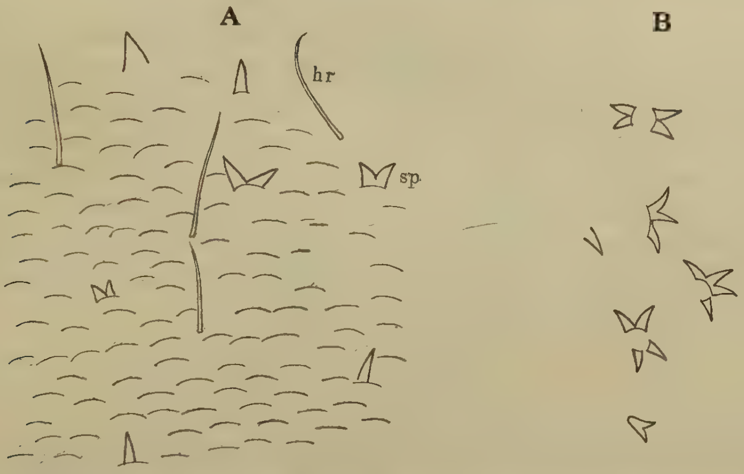


Fig. 5. A, scale-like ornamentation, with hairs (hr) and chitinous spines (sp), seen on the mantle a little below the operculum. ×335. B, various forms of chitinous spines. ×420.

ATTACHMENT-DISC. The rostral side of the mantle below the operculum is permanently attached to the wall of the burrow in which the animal is lodged, forming the disc for attachment. In most cases, it does not extend to the lower extremity of the mantle, but often more downwards in fully matured specimens. The upper end of the disc which is supposed to be the initial position of attachment, is strongly produced like a knob (Fig. 4, *u.p.d*), and stands free from the rostral end of the operculum, being inserted a deep notch between.

The disc is apparently flask-shaped or spatulate in outline, gradually tapering upwards and roundly ended at the base. It is convex outwardly, more in its narrowed upper part than in the rounded lower part. When the animal is carefully removed from the wall of the burrow, it appears that the uninjured upper portion of the disc, about 0.2–0.3 mm in width, is coated with a longitudinal series of small cuticular laminae which become thinner and generally obliterated downwards. This continuous cuticular covering adheres so firmly to the wall that can be hardly detached without damage. The formation of this cuticular laminae, as will be discussed in later papers, reminds one of the act of moulting accompanied by the excavation in the rock-boring pedunculate cirriped *Lithotrya* (DARWIN, 1851; SEWELL, 1926; CANNON, 1935). As in the case of *Lithotrya*, the whole chitinous covering is periodically cast at each moult, fresh laminae taking the place of the old ones worn down by boring. But old ones early attached to the wall remain permanently, so that a series of new laminae periodically added to older ones might be formed there.

The upper projection of the disc is firmly attached to the under side of a roof formed at the rostral end of the slit which is close-fitting to a deep notch below the rostral end of the operculum, so that it is hidden from upper view. This slight roof protruded above the disc is usually overlaid by a calcareous lining more thickly than elsewhere, hence it may mislead to be a product of the animal itself. AURIVILLIUS (1894) states the disc of *Lithoglyptes indicus* to be wholly calcareous, but in my opinion it may be nothing but a calcareous lining secreted only to anchor itself so firmly to its hollow: now it remains, however, to discuss the mechanism by which the secretion of calcium carbonate is taken place.

Body and its Segmentation

GENERAL OUTLINE. As usual in all known Acrothoracicans, the body proper enclosed within the mantle-sac is considerably elongated, tapering posteriorly and curved ventrally near the posterior end like a hook. It is widest at the anterior (or upper) portion, namely the head (Fig. 6, *H*). At rest, when the cirri are withdrawn into the mantle, the body is apparently S-shaped. It is somewhat compressed laterally in the upper portion, while more compressed dorsoventrally in the terminal crooked portion, where 5 pairs of multi-articulate, biramous thoracic appendages of considerable length are situated ventrally (Fig. 6, c_2–c_6); these appendages are named 'terminal cirri'.

The upper surface of the head, which corresponds to the frontal side of the labrum in ordinary cirripeds, is very broad, about one-third as long as the operculum, and lies horizontally parallel to the orifice, leaving a narrow interspace below the orifice. At its upper ventral corner forming a right angle, a developed oral cone or mouth (*m*) is situated. Below the mouth there is the first pair of thoracic cirri, usually called 'mouth cirri' (c_1) with a long protopodite is situated.

SEGMENTATION OF BODY PROPER. The body consists of a head and a thorax as in ordinary cirripeds. In all Acrothoracicans, however, it is a very difficult and unsatisfactory problem to determine the line between the head and the succeeding thorax and also to trace the segments of the latter. Thus, the former views on this problem are very divergent, and the problem remains unsettled. In this respect, my observations on this *Berndtia* from a new point of view, though not always convincing, may give a more probable interpretation on the segmentation that has been most disputed.

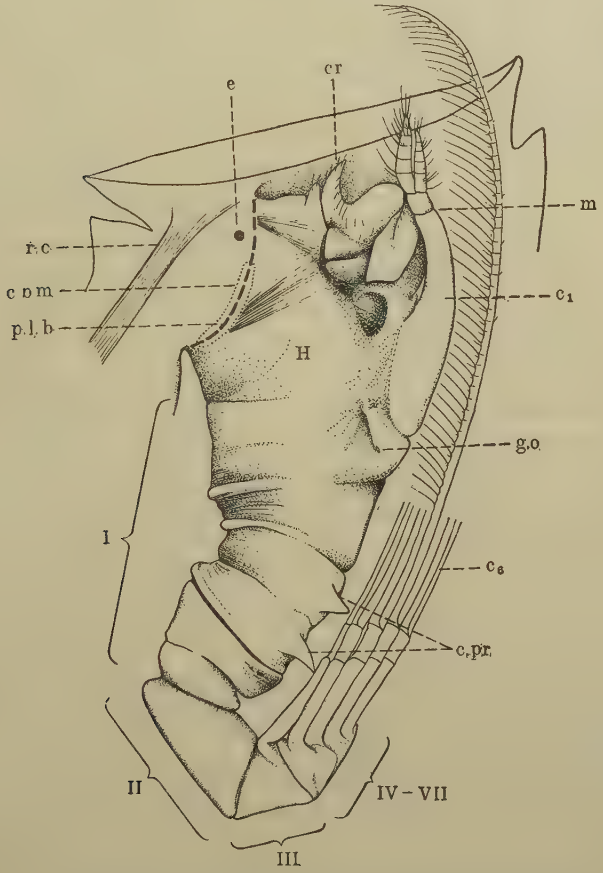


Fig. 6. Body proper within the mantle, showing the segmentation and appendages semidiagrammatically. Roman numerals show the number of thoracic segments. Other lettering as on p. 26. ×20.

As often pointed out by previous authors, there is no distinct trace of segmentation in the anterior portion of the body without appendages. So it is very problematic to consider some transverse folds, either distinct or indistinct, as the joints between the thoracic segments. Apparently the anterior portion of the body in

Berndtia may be divided into seven regions by six, more or less distinct, transverse folds. These folds are usually found in most examples, but do not completely surround the body, since any distinct introversion of cuticular covering is not formed along them. Therefore, these cannot very well be looked upon as the true segments regulated functionally. I am thus inclined to consider them as the secondary modifications due to the incessant contraction of the body. In another word, it represents rather a functional boundary, for the constitution of the body wall differs from that of the true thorax of ordinary cirripeds. The anterior portion concerned is to be regarded as the prosoma prolonged posteriorly or downwards, instead of a number of thoracic segments fused together. In the following description, for the sake of convenience, I shall use the term 'pseudosomite' for divisions formed on the lengthened prosoma. This is supported by the arrangement of internal musculature which will be described in fuller detail, when the internal anatomy is dealt with.

In ordinary cirripeds, the head is always fused with the first thoracic segment without trace of suture and profoundly expanded like a laterally compressed globe, forming the so-called 'prosoma'. This can be applied to the case of Acrothoracica too, though the outline of the prosoma is much elongated as a result of downward-extending growth in relation to the boring action.

A little below the line of connection between the body and mantle, the body is usually more or less inflated on each side, and below this the external membrane is folded transversely. This incomplete fold indicates the line of fusion between the head and the first thoracic segment. The succeeding region close to the head, bearing the mouth-cirri on the ventral side, is somewhat swollen at the base of the cirri, and separated by a more or less distinct transverse fold from the lower region; this region, which I call the first pseudosomite, may correspond to the first thoracic segment called by most of previous authors. A pair of oviducts run transversely along this region underneath and open to the exterior at the base of a slight elevation beneath the mouth-cirri; its opening (*g.o*) is very minute so that it may be hardly distinguishable from the outside.

In the succeeding regions, the transverse folds of the external membrane become more distinct downwards, and thus it may be divided into five pseudosomites. The second pseudosomite is bare and strongly wrinkled on the dorsal side. The third and fourth ones, which are divided by a slight fold on the dorsal side, but bear each a pair of conical processes (*c.pr*) on the ventro-lateral side. This conical process reminds one of the "zwei gerundet-konische Höckerpaare wie Zitzen" (AURIVILLIUS, 1894) in *Lithoglyptes indicus*. These processes have been considered the vestige of thoracic appendages by AURIVILLIUS. Most probably, however, as supposed above, they are homologous with the filamentary appendages found in some members of pedunculate cirripeds, such as the families Oxynaspididae, Lepadidae and Poecilasmatidae; their nature has not been confirmed, but they are likewise bare, flexible and structureless, being not supported by any muscle internally.

At the end of the fourth pseudosomite, the body is prominently folded and an yellowish thick chitin is inserted all along the fold. Internally, a series of anterior longitudinal dorsal muscles and that of posterior longitudinal dorsal muscles are articulated here; details of musculature will be described in later papers. The demarcation between the fifth and sixth pseudosomites is represented by a slight fold.

At the end of the sixth pseudosomite, the body is considerably constricted and then bent ventrally. The succeeding region towards the lower extremity is distinctly segmented and apparently divisible into three segments. By closer examination, however, it may be defined that the last one consists of four segments which became completely fused tegether. Therefore, the crooked terminal portion of the body is clearly composed of six thoracic segments, namely from the second to the seventh (Fig. 7).

The second segment (Fig. 6, *II*) is much compressed dorsoventrally and, as seen from the side, subtriangular in outline, and its frontal part of the dorsal wall is usually produced upward into a rounded knob. The succeeding third segment is likewise compressed dorsoventrally, triangular in lateral aspect and shorter than the second; at its narrowest ventral margin a pair of long thoracic cirri are borne. The fourth to seventh segments are, as mentioned above, fused together, but traces of distinct or less distinct sutures are defined on the dorsal side, and each bears a pair of thoracic cirri on the ventral side. The terminal end of the body is formed only of two simple rounded lobes which are divided by a distinct median notch. No caudal appendages can be traced. All these terminal segments are covered with a thick and yellowish cuticular membrane, and colored purplish as in the operculum and upper portion of the head (Fig. 7).

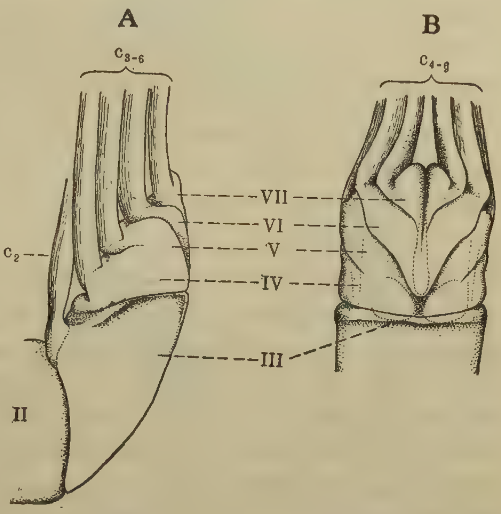


Fig. 7. Terminal portion of body, showing the fused thoracic segments carrying the cirri respectively. A. lateral view. B, dorsal view. Roman numerals show the number of thoracic segments. Other lettering as on p. 26. ×55.

Oral cone and Mouth-parts

ORAL CONE. As usual in the Acrothoracica, the oral cone or mouth is very developed for the size of the body itself and consists of buccal appendages of ordinary type, though peculiar in every part. Unlike that of ordinary cirripeds, the mouth is not probosciformed and situated near the orifice at the anteroventral corner of the head, so that the upper surface of the labrum is perpendicular to the outer maxillae.

Before describing the mouth-parts, it is to be noted that there is a peculiar crest-like projection (Fig. 6, *cr*) in front of the labrum. It is bullate, obtusely pointed and curved backwards. Such a projection is not mentioned for *Lithoglyptes*, but reminds one of 'a little knob' in front of the so-called 'lancet-shaped labrum' or 'Labrumzapfen' of *Cryptophialus*. This seems homologically to be a prolongation of the fronto-basal part of the labrum, where it is a little swollen only in most of the Lapadidae.

The mouth consists of a labrum and four pairs of mandibular palpi, mandibles, maxillae I and maxillae II. These organs show a close resemblance to those of *Lithoglyptes indicus* figured by AURIVILLIUS (1894) and BROCH (1931). Concerning their affiinity, BROCH suggests a closer resemblance to Lapadidae s. str., while KRÜGER (1940) to Balanidae. In my opinion, however, these, as in *Lithoglyptes*, exhibit a striking likeness with those of *Ibla*, a pedunculate cirriped living usually attached to the peduncle of another littoral cirriped *Mitella*.

LABRUM. The labrum itself is bullate. Its inner edge is semicircular in outline and furnished with a row of feeble teeth throughout. The surrounding part is broadly expanded and somewhat pointed at the median distal end, and planted sparsely with hairs.

PALPI. The palpi (Fig. 8, E) are attached, on each side, to the lateral edges of the base of labrum and project upwards. They are elongate, tapering, flattened and fringed with stiff hairs at the distal end and along the inner edge. Seen from the ventral side, the inner edge bearing hairs seems to face upwards and towards the side opposite to the mouth owing to its distortion. In every ordinary cirriped, however, the corresponding edges on both sides are directed inwards and face to each other across the mouth-opening under the labrum. This may be caused by the fact that the mouth is, in all Acrothoracicans, situated closely below the mantle opening and thus directly exposed to water pouring into the mantle cavity. The similar feature has been noticed by DARWIN in *Cryptophialus*, but he did not explain why it is so.

MANDIBLES. The mandibles (Fig. 8, A–B) are very developed and powerful. The free edge is provided with 3 or 4 strong teeth and a pectinated lower angle; the teeth on both sides are usually asymmetrical in number. The uppermost one of the teeth is strongest and widely separated from the second. The upper edge of the blade is devoid of hairs but the lower edge and the lower half of the lateral surfaces are clothed with hairs.

MAXILLAE I. The maxillae I (Fig. 8, C) are furnished with 2 strong and 1 or 2 shorter spines above a very broad notch lying in the middle of the free edge. Below the notch about 10 spines of similar size but shorter than the upper two, occur on the median part, and about 5 much shorter ones on the lower part. Around the free edge only the lateral surface is densely hairy. At the lower edge near the proximal end, a very long, rigid apodeme is attached.

MAXILLAE II. The maxillae II (Fig. 8, D) are remarkably developed and largest; they stand erect and altogether cover the whole opening below the labrum. Each blade is a simple, elongate, much swollen and trihedral lobe, with a slight notch indicating the suture between the upper and lower segments fused together in the middle of the inner surface. The outer surface of the upper segment is rounded and densely covered with long hairs, while the inner surface forms a sharp ridge fringed with shorter hairs. The tip is sharply pointed and slightly incurved. The lower segment is very broad and devoid of hairs at all.

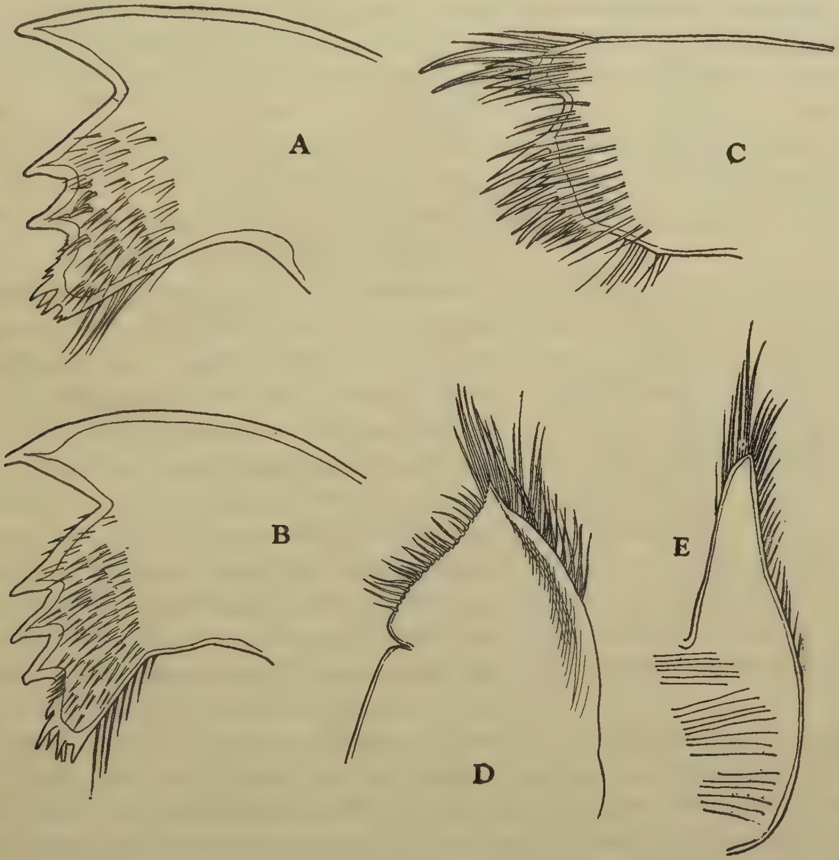


Fig. 8. Mouth-parts. A, B, mandible. C, maxilla I. D, maxilla II. E, mandibular palp. A C, ×150; D, E, ×80.

Cirri

The thoracic appendages consist of the first oral and the second to sixth terminal cirri, all of which are borne on the ventral side. Each of the cirri bears, as usual in ordinary cirripeds, two multi-articulate rami and a protopodite formed of two segments. The bases of the cirri on both sides are in close contact with each other along the medial line of the ventral wall.

Mouth-cirri. The first pair, as usually called the 'mouth-cirri' (Fig. 6, c_1), is closely approximated to the mouth and widely separated from the remaining cirri which are crowded together at the terminal end of the body. The protopodite is very prolonged and proceeds upwards in contact with the ventral surface of the head, nearly extending to the distal angle of the labrum. Its lower segment is very bullate and thickly clothed with fine hairs anteriorly, while the upper segment is very short, not over one-fifth of the length of the lower one, and unhairy. The two rami on the protopodite are also short, about one-fourth to one-fifth as long as the protopodite; the anterior ramus is a little longer and wider than the posterior and usually curved backwards. Both rami are distinctly segmented and thickly clothed with fine long bristles and plumose like a feather.

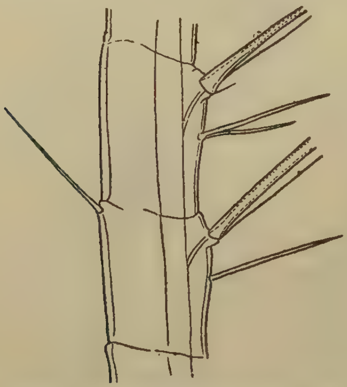


Fig. 9. Two segments of terminal cirri. ×210.

Terminal cirri. The five pairs of the thoracic cirri at the terminal part of the body, namely the terminal cirri (Fig. 6, c_{2-6}), are almost exactly alike, excepting that the second pair is a little shorter than the succeeding pairs. In all these cirri, the protopodite is comparatively slender and consists of two segments of which the lower segment is about thrice as long as the upper one, both carrying fine hairs ventrally. The rami are more or less distinctly segmented, being only defined by the manner of arrangement of bristles on the ventral side. Each segment, when it is distinct, bears a paired longer and a paired or single shorter bristles on the ventral side and a single short bristle at the dorsal distal angle (Fig. 9).

In most cases, the posterior ramus is a little longer than the anterior in the third to sixth cirri, while a little shorter in the second cirri. For comparison the number of segments with the length of each ramus in a specimen dissected (5–6 mm long and 3 mm wide) is given below:

	Mouth-cirri		Terminal cirri									
	I		II		III		IV		V		VI	
	a	p	a	p	a	p	a	p	a	p	a	p
Total length (in mm)	1.65	1.48	3.45	2.5	4.1	4.65	5.35	5.65	5.55	5.63	5.65	5.68
Number of segments	6	5	26	16	36	46	47	56	56	57	59	61
Length of protopodite (in mm)	1.2		1.1		0.9		1.0		1.0		1.1	

a: Anterior ramus. p: Posterior ramus.

Cirral Movement and Feeding Habit

Cirral movement. In connection with describing the external morphology, some observations on the cirral movement which I have made on living specimens in the laboratory should be mentioned. The cirral movement and the method of food-seizure in ordinary cirripeds have been studied by some authors since Darwin. As to the Acrothoracicans, the works of Aurivillius (1894), Berndt (1903), Genthe (1905) and Nilsson-Cantell (1921) on *Trypetesa lampas* since the classical work of Darwin are only known. The last-named author has published a concise summary of the process in detail.

As far as my observation goes on, the cirral movement of *Berndtia* seems quite different from that of *Trypetesa lampas*. In ordinary cirripeds living in the littoral, such as *Balanus balanoides*, *B. crenatus* and *B. balanus*, the feeding habit as a whole may be summarized as follows :—

"Die *Balanus*-Arten sind durch lebhafte Bewegungen ausgezeichnet; alle Cirren und Rami werden gleichzeitig in der Weise bewegt, dass die Cirren zuerst ausgestreckt und dann auf einmal gegen den Mund zu gebogen werden, wobei sich der Körper zugleich etwas in die Schale senkt. Die Bewegungen können, besonders bei kleineren Exemplaren, ausserordentlich lebhaft sein. So konnte ich z. B. bei 1–2 mm grossen Exemplaren bis 140 Schwingungen in einer Minute zählen. Diese Bewegungen werden während eines grossen, und besonders der dunkleren Teiles des Tages ausgebührt. Ziemlich wahrscheinlich erscheint Gruvels Vermutung, dass diese Bewegungen nicht allein den Nahrungsfang zum Zwecke hätten, sondern auch die Aufgabe besässen, das Wasser der Mantelhöhle zu erneuern und zur Zirkulation des Blutes im Körper beizutragen.......Für *Balanus* ist somit charakteristisch, dass sich die Cirren *nicht unabhängig* voreinander, sondern *gleichzeitig* bewegen" (after Nilsson-Cantell, 1921, p. 78).

In comparison with the above comment, the feeding habit of *Berndtia* is of great interest, because the body itself does not protrude out of the orifice even if the terminal cirri are fully stretched. In any time the animal at first uplifts the posterior (carinal) side of the whole mantle a little above the entrance of its burrow until the cirri begin to move. The anterior (rostral) end of the operculum is simultaneously uplifted as well, but very slightly. Such a posture is kept continuously during the time of cirral movement as it is. In normal and most favourable condition, all terminal cirri are perfectly protruded out of the orifice, and expanded fully in a fan-like shape, as shown schematically in Fig. 10.

When viewed from the above, the rami of the fourth to sixth pairs are set apart from each other in the same cirri and close to the adjoining rami of the different cirri. The third pair of the cirri is a little separated from the fourth and more widely from the second, and then somewhat occupies the lateral position, if considering the whole in such an expanded state as a 'casting-net' (after Calman, 1909, p 114). The rami of the second pair representing the lower portion of a net are protruded horizontally, as lying a little above the operculum. When the net is cast out, the cirri are not coiled up independently, excepting only that the second pair can bend a little inwards. All the rami do not move independently but simultaneously, as is the case with those in ordinary cirripeds living in the littoral.

In most cases, the cirri do not keep the stretched state for a long time, but at times rotate about an axis as they are stretched. But they are, as usual, soon withdrawn altogether into the mantle cavity without coiling up as they are fully stretched. This casting movement, much like that of other coral-inhabiting cirripeds (*Creusia* and *Pyrgoma*) lodged on the same coral colony, is repeated rhythmically about 24–25 times per minute, but often interrupted with short or long irregular pauses. It is thus not so vigorous as in other ordinary cirripeds as well as *Trypetesa*. The greater the animal weakens owing to a longtime culture in aquaria, the more irregular the cirral movement becomes and the pause lasts for a very long time. Hence the rate of pulsation seems considerably variable in individuals.

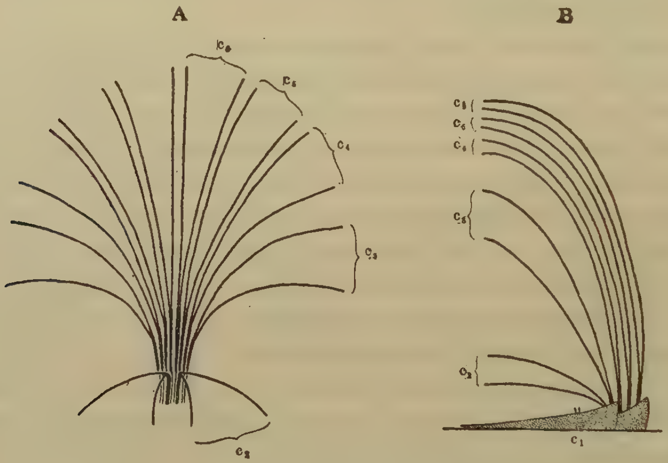


Fig. 10. Diagram showing the fully stretched state of cirri forming a 'casting-net'. A, frontal view. B, lateral view. Lettering as on p. 26.

SENSITIVITY. The sensitivity of the cirri in the Acrothoracica to any stimulus is very little known, with only a brief note by GENTHE for *Trypetesa*, that is, "To a light touch the animal usually, but by no means always, responds by ceasing the rhythmical movements and often contracting the mantle lips besides." *Berndtia* is very sensitive to an appropriate decrease of illumination, though not always, as is also the case with most of the *Balanus*-species (COLE, 1929, 1932). This evidently depends upon the reaction of the unusually developed eyes which are embedded in the connective tissue under the operculum but refulgent through the epidermis.

If a shadow is cast on the animal, the cirri are quickly withdrawn into the mantle cavity, and the operculum is closed. But soon they are protruded and extended fully. To stronger stimuli the animal responds by an immediate retraction of the cirri and withdrawal of the whole body into its burrow. The length of the period of retraction following a decrease of illumination depends upon the degree of the decrease. To an increase of illumination, however, there is no remarkable response as such.

The response of the cirral movement to the tidal or diurnal rhythm could not be observed. But from its natural habitat it seems probable that there is no remarkable regularity between them.

Feeding mechanism. It is undoubted that the above-mentioned rhythmical movement of the cirri produces an inflow of water current. The current, on one hand, carries food particles into the mouth, and on the other renews the water in the mantle cavity and serves for the respiration as well as the circulation of brood. As has been stated above, the 'casting net' for capturing food which is formed of the expanded five terminal cirri, is always directed towards the rostral side, instead of being upwards as usual in the Balanidae (cf. Fig. 10, B). When food particles are carried in front of the net, the terminal cirri are used together for capturing them, but their duties seem to be separate from one another. The second cirri alone can work independently, though not always.

When a food first touches the back portion of the net which is formed of the close-set three pairs of the cirri (IV–VI), it is kept in the middle of the net by the third cirri of both sides from escapement, and then caught by the second cirri at the bottom of the net. Then the food is eventually conveyed to the mantle cavity by the following retraction of all the cirri. When the cirri are perfectly retracted, the thorax is a little pushed forwards and contracts at the same time. In this connection it is to be noted that the second cirri are set apart from the remaining cirri and expand themselves, so that the rami are almost perpendicular to the lower parts of the other cirri and lying in a plane parallel to the surface of the operculum. In this position it is easier for its relatively shortness to other cirri to seizure food. So it seems probable that although these five pairs of the terminal cirri are morphologically almost alike, the first one (really the second thoracic cirri) functionally corresponds to the anterior three pairs of shorter cirri in the Balanomorph Cirripedia, whereas the remaining four to the posterior three pairs of longer cirri.

Food. Regarding the food of *Trypetesa lampas* which burrows itself into the gastropod-shells inhabited by hermit-crabs, Genthe states that "It evidently feeds on very finely distributed organic matters, be that fine particles which pass into the water when the crab cuts and prepares its food, be that faecal matter." The same may be said for the present animal.

On examination of the contents of the digestive canal in both fresh and preserved materials, I took in vain to find any trace of corporal matter, as they were invariably filled with brown slimy substances. This may be due to the probable rapidness of digestion, provided that they can prey any planktonic organism. However, this animal, as well as other Acrothoracicans, is too small to take wholly the planktonic organisms of a relatively small size, since its mantle opening is less than 1 mm in diameter. It is thus probable that all the Acrothoracicans feed upon minute organisms or any organic debris alone floating in water, as large as passing into the orifice. The food in this species may be afforded also by the host corals as remnants of their own animal foods or as debris of vegetable matter which is invariably refused by the coral.

On one occasion I happened to observe that the outer cuticular exuviae of its own cast off after moulting are subject to be eaten by the host coral.

SWEEPING MECHANISM. The foregoing description does not apply to the mouth-cirri. These are not only separated by a wide space from the remaining cirri which are crowded together at the posterior end of the body (cf. Fig. 11), but their constitution considerably differs from the latter

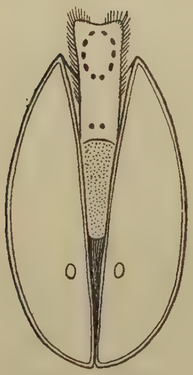


Fig. 11. Diagram of operculum showing the position of cirri, when the orifice is opened. Black points show the position of cirri and two open spots in the operculum the position of eyes.

According to NILSSON-CANTELL (1921), the respiratory current in *Trypetesa* constantly circulates in the mantle cavity, passing through the slit-like opening which is divided into two partitions, inharent and exharent. He says that "Partikeln wurden in diesem (unteren oder rostralen) Teil des Capitulums eingeführt, zogen am Munde und den Mundcirren, an denen einige hängen blieben, wobei bis zum carinalen Teil der Mantelhöhle, wo sie der austretende Strom ergriff und durch den Oberen Teil der Öffnung aus der Mantelhöhle hinausleitete. ......Für das Einströmen haben die Bewegungen der Mundcirren, für das Ausströmen jene der hinteren Cirren die grösste Bedeutung."

From his statement it seems clear that the mouth-cirri in *Trypetesa* play an important rôle in the seizure of food, although they have been considered by former authors as acting as brushes for sweeping. Moreover, the peculiar bands of stiff bristles on both sides in front of the mouth appear probably act as an efficient sieve for capturing food and at the same time as a hedge, barring the ingress of any harmful intruder into the sac, as was supposed by GENTHE. Such band of bristles does not occur in any other genera of the Acrothoracica and in ordinary cirripeds; apparently it answers functionally to the net forming of terminal cirri in other Acrothoracicans as well as ordinary cirripeds. These peculiarities in function as well as structure are probably correlated with the unusual modification of the body proper, in particular as to the reduction of the thorax and thoracic cirri, as the terminal cirri cannot be protruded outside. In all other Acrothoracicans, however, the terminal cirri can be protruded altogether.

In *Berndtia*, on the other hand, the current within the mantle cavity seems to be reversible along the same tract near the carinal side in accordance with the extension and contraction of the body itself together with the terminal cirri. When the terminal cirri are fully protruded, the mouth-cirri are also stretched upwards, but only slightly protruded beyond the orifice (cf. Fig. 10B, c_1). Therefore the mouth-cirri are not concerned wholly with the terminal cirri functionally, but solely act as brooms, sweeping around the orifice.

Namely, the carinal half of the orifice, through which the terminal cirri are exserted, is swept by the terminal brush of the rami of the mouth-cirri, which can bend towards the carinal side only, even when the terminal cirri are not exserted. It can quite clearly be seen by observing on the living animals and be proved by dissection for the examination of the internal structure. Any harmful object intruding from outside is eventually prevented by the comb-collar around the margin of the orifice, together with brushes of fine hairs a little below the orifice, all being pointing upwards.

In addition, it seems probable that mucus, which is secreted by the host coral in large quantities, plays an important part in entangling the silt or calcareous detritus cast down during the process of excavation, and then in cleaning the orifice. The sweeping movement is further aided by water current in the circumferences. In a most specialized Acrothoracican, *Cryptophialus*, on the other hand, the so-called lancet-shaped labrum, which became modified into an unusually prolonged movable organ because of the reduction of the mouth-cirri, may play a similar part to the mouth-cirri of *Berndtia* as well as other Acrothoracicans.

Anyhow, the sweeping movement as stated above appears to be a specialized function in the group of Acrothoracica, that is closely correlated with the feeding habit. It is undoubtedly a physiological phenomenon adapted to the burrowing mode of life.

Summary

1. The investigations on the boring cirripeds, Acrothoracica, with special reference to the two species, *Berndtia purpurea* and *Balanodytes taiwanus* which were recently described as new representatives by myself, are published in a series of papers. This paper, forming the first part of the series, deals only with the biology and external morphology of the female of the former species.

2. *Berndtia purpurea* is invariably found boring in the living part of the two reef corals, *Leptastrea purpurea* (DANA) and *Psammocora profundacella* GARDINER, and none in other corals.

3. It is distributed mainly on the Pacific coast of southern Japan, but may range further southwards to Formosa and Micronesia. Only an exceptional example was found, that is, a specimen of *Podabacia crustacea* (PALLAS) from Singapore heavily infected by an Acrothoracican borer like *Berndtia*.

4. When alive, the mantle-lips forming together an operculum, which is close-

fitting to the slit of burrow, are marked with two distinct bands of violet-blue patterns, which anteriorly with a golden glistening body (eye) on each side.

5. The orifice between the mantle-lips is hinged at the rostral end, while its carinal end forms a flexible velum folded outwards, serving to open and close the orifice.

6. A little below the operculum, the lateral sides of the orifice are fringed with a comb-like row of flattened setae, acting as a barrier to prevent foreign harmful intruders. This is a specialized structure peculiar to the Acrothoracica adapted to its burrowing life.

7. The 'lateral bar' situated close to the attachment-disc is nothing but a chitinous thickening of the external membrane, which serves as a fulcrum at each excavation or contraction of the mantle.

8. The 'attachment-disc' is flask-shaped in outline and at its upper portion forms a continuous series of cuticular laminae which remain at each moult, as they are not cast off with other exuviae.

9. The body within the mantle-sac consists of a large head and seven thoracic segments tapering posteriorly. The anterior portion of the thorax fused with the the head, namely, the 'prosoma' is much prolonged and differentiated into 6 'pseudosomites' by transverse folds, whereas the posterior crooked portion is distinctly segmented and its last one clearly represents four thoracic segments fused together with traces of articulations.

10. Two 'conical processes' found on the ventrolateral sides of the prolonged prosoma seem probably homologous with the filamentary appendages in some genera of ordinary cirripeds, instead of being vestiges of the cirri.

11. The cirri consist of one pair of the 'mouth-cirri' and five pairs of the 'terminal cirri'. The mouth-cirri may act as brooms to sweep around the orifice and the terminal cirri serve mainly for the seizure of food by forming a 'casting net'.

REFERENCES

AURIVILLIUS, C. W. S. 1894. Studien über Cirripeden. Kungl. Sv. Vetensk. Akad. Handl., Bd. 26, no. 7, pp. 1–107, pls. 1–9.

BERNDT, W. 1903. Zur Biologie und Anatomie von *Alcippe lampas* Hancock. Inaug. Diss., Univ. Berlin (1902); Zeitsch. wiss. Zool., Bd. 74, Ht. 3, pp. 396–457.

——— 1907. Studien an bohrenden Cirripedien (Ordnung Acrothoracica Gruvel, Abdominalia Darwin). I. Teil: Die Cryptophialidae. Arch. Biontol., Bd. 1, pp. 167–210, pls. 14–17.

BRATTSTRÖM, H. 1956. On the organization of the genus *Baccalaureus* (Ascothoracica) with description of a new South African species. In: Bertil Hanström, Zool. Papers in honour of his 65th birthday (Edited by K. G. Wingstrand), pp. 106–119. Lund.

BROCH, Hj. 1931. Papers from Dr. Th. Mortensen's Pacific Expedition 1914 16. LVI. Indomalayan Cirripedia. Vidensk. Medd. Dansk naturh. Foren., Bd. 91, pp. 1–146.

CALMAN, W. T. 1909. The Cirripedia. In: A treatise on zoology (Edited by R. Lankester), Pt. 7, Fasc. 3, Crustacea, pp. 106–142. London.

CANNON, H. G. 1935. On the rock-boring barnacle, *Lithotrya valentiana.* Sci. Rep. Gt. Barrier Reef Exped. 1928–1929, Vol. 5, no. 1, pp. 1–17, pls. 1–2.

CANNON, H. G. 1947. On the anatomy of the pedunculate barnacle *Lithotrya*. Phil. Trans. Roy. Soc. London, Ser. B, Biol. Sci., Vol. 233, no. 595, pp. 89–136.

COLE, W. H. 1929. The relation between temperature and pedal rhythm of *Balanus*. Journ. gen. Physiol., Vol. 12, pp. 599–608.

——— 1932. The sensitivity of the cirri and the variability of their movements in the barnacles *Balanus tintinnabulum* and *B. balanoides*. Journ. Exper. Zoöl., Vol. 63, pp. 143–153.

DARWIN, Ch. 1851. A monograph on the sub-class Cirripedia. The Lepadidae. London. xii+400 pp., 10 pls.

——— 1854. A monograph on the sub-class Cirripedia. The Balanidae, the Verrucidae, etc. London. viii+684 pp., 30 pls.

GENTHE, K. W. 1905. Some notes on *Alcippe lampas* (Hanc.) and its occurrence on the American Atlantic shore. Zool. Jahrb. Abt. Anat., Bd. 21, Ht. 2, pp. 181–200.

HIRO, F. 1937. Occurrence of an acrothoracican cirriped in Japan. Zool. Mag. (Tokyo), Vol. 49, no. 3/4, pp. 135–136. (In Japanese)

——— 1938. Studies on the animals inhabiting reef corals, II. Cirripeds of the genera *Creusia* and *Pyrgoma*. Palao Trop. Biol. Sta. Stud., Vol. 1, no. 3, pp. 391–416.

KRÜGER, P. 1940. Cirripedia. Bronns Klassen und Ordnungen des Tierreichs, Bd. 5, Abt. 1, Buch 3, Teil 3. Leipzig. 560 pp.

MA, T. Y. H. 1937. On the growth rate of reef corals and its relation to sea water temperature. Mem. Nation. Inst. Zool. Bot., Acad. Sinica, No. 1, Text, 226 pp.; 100 pls. Nanking.

NILSSON-CANTELL, C.-A. 1921. Cirripeden-Studien. Zur Kenntnis der Biologie, Anatomie und Systematik dieser Gruppe. Zool. Bidr. fr. Uppsala, Bd. 7, pp. 75–390, pls. 1–3.

SEWELL, R. B. S. 1926. A study of *Lithotrya nicobarica* Reinhardt. Rec. Ind. Mus., Vol. 28, pt. 4, pp. 269–330.

TOMLINSON, J. T. 1953. A burrowing barnacle of the genus *Trypetesa* (order Acrothoracica). Journ. Wash. Acad. Sci., Vol. 43, no. 11, pp. 373–381.

UTINOMI, H. 1950a. A new remarkable coral-inhabiting Acrothoracican cirriped. Mem. Coll. Sci. Univ. Kyoto, Ser. B, Vol. 19, no. 3, pp. 83–89, pl. 1.

——— 1950b. On another form of Acrothoracica, newly found from Formosa. *Ibid.*, Vol. 19, no. 3, pp. 91–96.

——— 1950c. General account of the Acrothoracica. In: Some problems of modern biology (Compiled by K. Nakamura), pp. 428–461. Osaka. (In Japanese)

YABE, H., SUGIYAMA, T. and M. EGUCHI 1936. Recent reef-building corals from Japan and the South Sea Islands under the Japanese mandate. I. Sci. Rep. Tôhoku Imp. Univ., 2nd ser. (Geol.), Spec. Vol. 1, pp. 1–66, pls. 1–59.

EXPLANATION OF PLATES I-II

Plate I

Fig. 1. Colored drawing from life of a female of *Berndtia purpurea* Utinomi, buried between three polyps of the coral *Leptastrea purpurea* (Dana), upper view. ×16.

Fig. 2. The same freed from its burrow, lateral view. ×16.

Fig. 3. The same buried within its burrow, with partially protruded cirri, carinal view. ×16. (All H. Utinomi del.)

Plate II

Fig. 1. A specimen of the coral *Psammocora profundacella* Gardiner heavily infected by *Berndtia purpurea* Utinomi. ×1.

Fig. 2. A section of a densely infected specimen of *Leptastrea purpurea* (Dana). ×1.

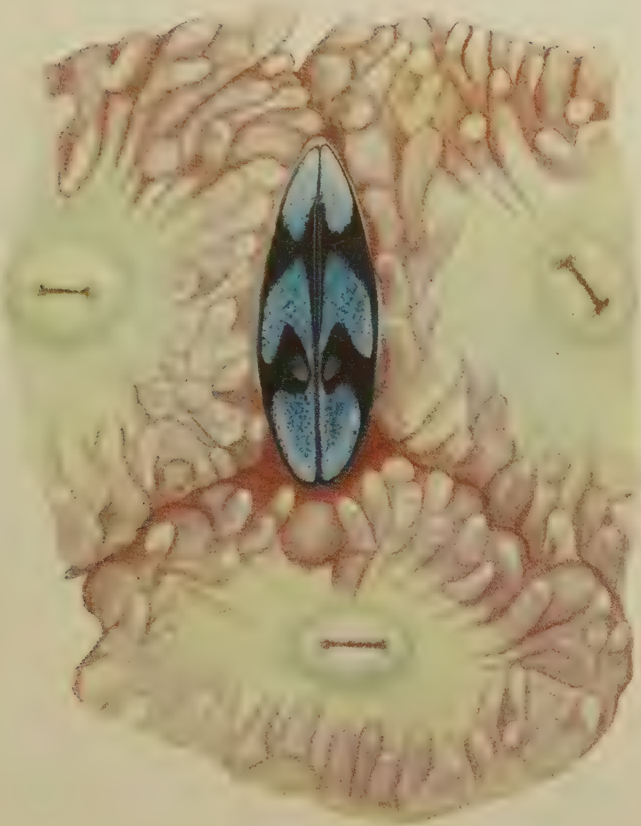
Fig. 3. A specimen of densely infected *Leptastrea purpurea* (Dana). ×1.

Fig. 4. Slits of burrows found on *Leptastrea purpurea* (Dana), highly enlarged. ×3.

(Scale at 3 applies to figs. 1–3 and scale at 4 only to fig. 4.)

List of Abbreviations used in the Text-figures

C	Carinal (ventral) side.
c_1	Mouth-cirri.
c_{2-6}	Terminal cirri.
c_{1-6}	Cirri I–VI.
c.b.m	Connecting line between body proper and mantle.
c.c	Comb-collar.
c.pr	Conical process.
cr	Crest-like projection.
e	Eye.
e.r	External ridge of operculum.
g.o	Genital opening.
H, h	Head.
hr	Hair.
i.r	Internal ridge of operculum.
l.b	Lateral bar.
m	Mouth.
o.s.m	Outer oblique muscle for supporting mantle-sac.
o.v	Orificial velum.
op	Operculum.
or	Orifice.
p.l.b	Position of lateral bar.
R	Rostral (dorsal) side.
r.c	Retractor corporis.
r.o	Retractor orificii.
r.o.i	Retractor orificii inferior.
r.o.s	Retractor orificii superior.
sp	Chitinous spine.
t.s.m	Inner transverse muscle for supporting mantle-sac.
u.h	Upper surface of head.
u.p.d	Upper projection of attachment-disc
v.p	Violet-colored pattern.



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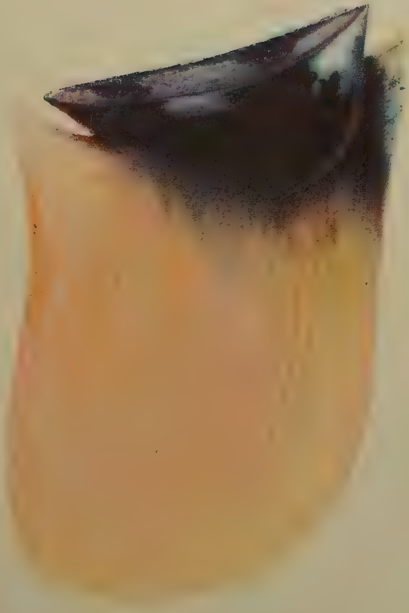

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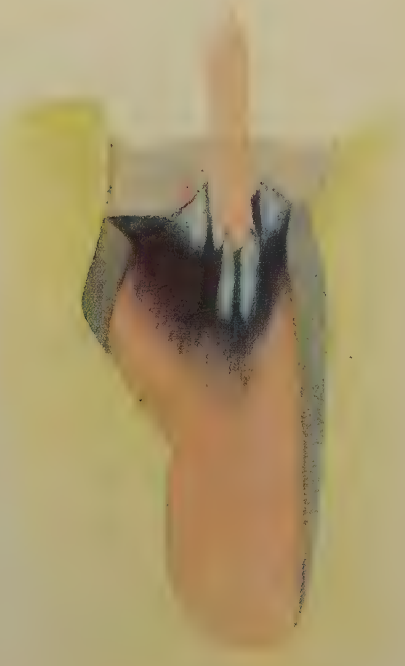

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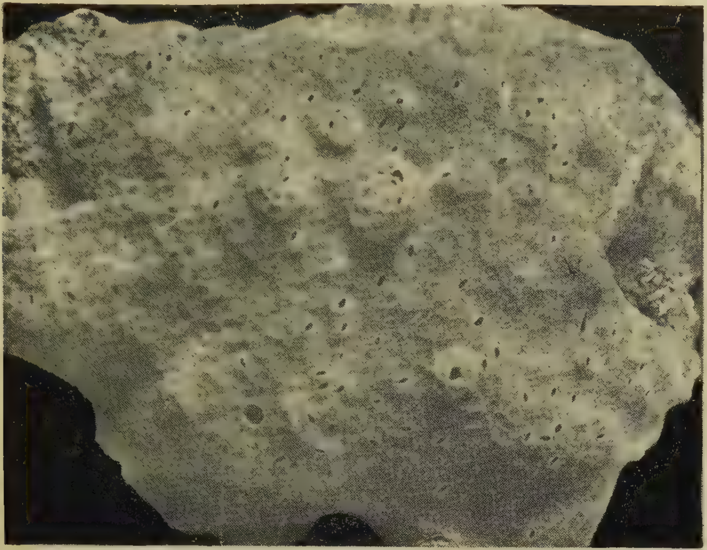

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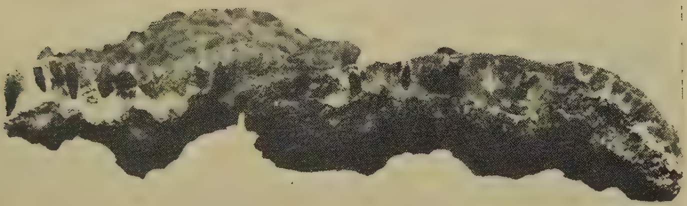

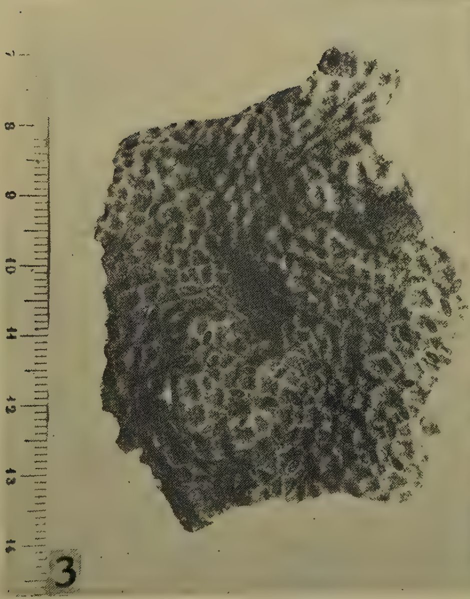
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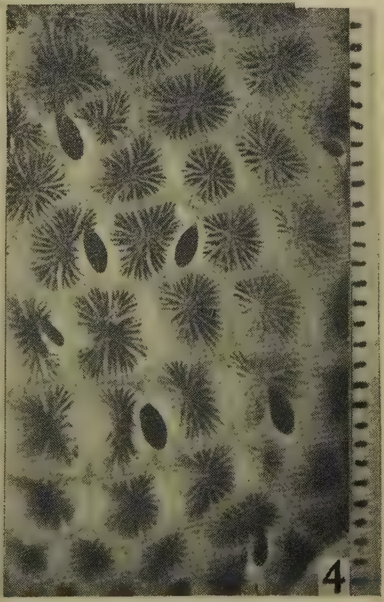

H. UTINOMI: STUDIES ON THE CIRRIPEDIA ACROTHORACICA, I.

ON A NEW GENUS OF THE FAMILY OOCORYIDAE[1][2]

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and
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With 5 Text-figures

In 1907, DALL[1] described *Galeodea leucodoma* based on the specimen collected by the "Albatross" from off Kagoshima, Japan, in 391 fathoms which was later figured in 1925.[2] Fortunately, this deep sea species has been recently rediscovered from Tosa Bay by Mr. Akibumi TERAMACHI who kindly placed the specimen containing the soft part at our disposal.

The dissection has revealed that this species should be transferred from the family Cassididae to the Oocoryidae by the following features: viz. the radula has a subquadrate central tooth bearing a triangular median cusp with several smaller lateral cusps on each side and the horn-shaped marginal teeth with a single cusp.

The shell of this species resembles somewhat *G. echinophora* (LINNÉ), the type species of *Galeodea* LINK, but differs in the short and less curved canal, without any crevices at the base behind the columellar reflection of lip. And the operculum is large enough, oblong and thick, dark brown, pointed behind, rounded in front; outer margin somewhat laminately erecting, forming a deep furrow on the inside of it; growth striae distinct; nucleus excentric, situated at the anterior three-fourths near the outer margin; subspiral.

This species closely relates to *Oocorys caribbaea* CLENCH and AGUAYO from the West Indies in having the distinctly nodular spiral series, the number of which is less than those of the other species of *Oocorys* and the shell is sufficiently solid.

Therefore, a new generic name, *Galeoocorys* is here proposed, designating *Galeodea leucodoma* DALL as the type species. The other member of this new genus may be "*Morio*" *granulosa* SCHEFMAN[3] from Indonesian sea, which has finer series of nodules than our species.

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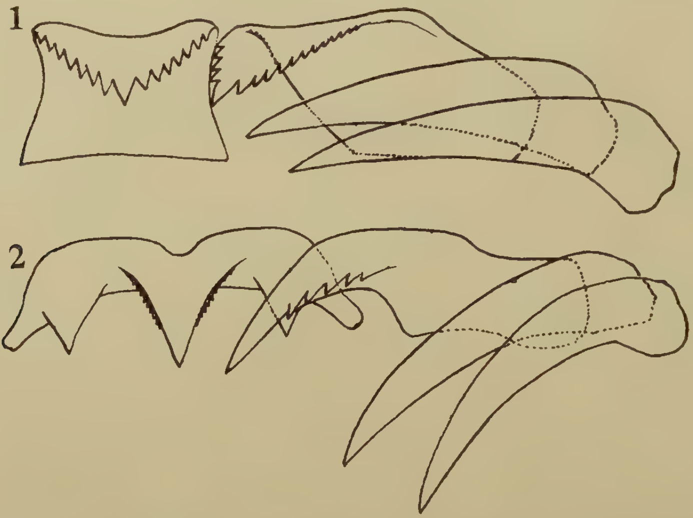
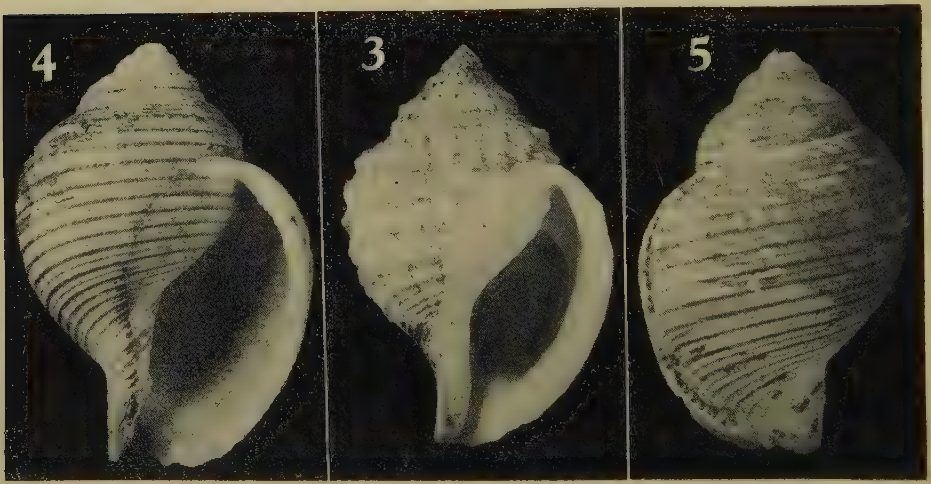
1) Contributions from the Seto Marine Biological Laboratory, No. 292.
2) Contributions from the Amakusa Marine Biological Laboratory (Kyushu University) No. 100.

Publ. Seto Mar. Biol. Lab., VI (1), 1957. (Article 2)

On this occasion, we shall deal with a species of Japanese Tonnidae. In 1948, Dr. R. TURNER[4] pointed out the fact that the Japanese specimen figured by OSIMA[5] does not agree with *Eudolium lineatum* (SCHEPMAN) which should be a member of Oocoryidae, standing close to *Eudolium crosseanum* (MONTEROSATO) from the Atlantic. The Japanese species is a real *Eudolium* with the embryonic shell peculiar to *Macgillivrayia*, and we already discriminated it giving a new name, *Eudolium inflatum*.[6]



Figs. 1 & 2. Radulae: 1. *Galeoocorys leucodoma* (DALL), 2. *Eudolium inflatum* KURODA et HABE.



Figs. 3–5. Shells: 3. *Galeoocorys leucodoma* (DALL) (64 mm in height and 43 mm in breadth.), 4 & 5. *Eudolium inflatum* KURODA et HABE (65 mm in height and 45.5 mm in breadth).

The radula of this species bears a large median cusp with many minute lateral cusps on each side of it and a large basal cusp on each side of the central tooth. Therefore it belongs to the typical group of the genus *Eudolium*, but not to *Oocorys*, as stated by Dr. R. TURNER.

REFERENCES

1) Smithsonian Misc. Coll., **50**, 166 (1907).
2) Proc. U. S. Nat. Mus., **66** (17), 17, pl. 34, fig. 4 (1925).
3) Siboga Expeditie, **41** (1), Prosobranchia, p. 123, pl. 10, fig. 4 (*Morio granulata* in the explanatory text).
4) Johnsonia **2** (26), 176 (1948).
5) Conchologia Asiatica, **I**, 133, pl. 5, fig. 1 (1943).
6) Check List Bibliogr. Rec. Mar. Moll. Japan, 56 (1952).

THE PELAGIC COPEPODS OF THE IZU REGION, MIDDLE JAPAN
SYSTEMATIC ACCOUNT III.
FAMILY AETIDEIDAE (PART 1)

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With 18 Text-figures

Family AETIDEIDAE

Genus *Aetideus* Brady, 1883

Up to the present time four species of this genus have been recorded: *Aetideus armatus* (Boeck), *A. giesbrechti* (Cleve), *A. bradyi* A. Scott, and *A. acutus* Farran. The genus has the following characters: head and first thoracic segment are fused, and so are the fourth with the fifth; lateral corners of last thoracic segment produced into an acute spine on each side; abdomen 4-jointed in female; first antenna 23-jointed, joints 8 and 9, joints 24 and 25 are fused; second antenna with endopodite about as long as exopodite; mandible has exopodite longer than endopodite; maxillae and maxillipede are of usual type; first leg with 3-jointed exopodite and 1-jointed endopodite, outer marginal spine only on second and third joints of exopodite; second leg with 3-jointed exopodite and endopodite; third and fourth leg with 3-jointed exopodite and endopodite; fifth leg absent in female. Male resembles female in general appearance, differing from it in the absence of rostral spine, in the number of abdominal segment, and in the structure of fifth pair of legs.

G. O. Sars divided the genus in two; *Aetideus* and *Euaetideus* on the ground that the shape of rostral spine is different; to the latter genus belong *A. giesbrechti*, *A. bradyi*, and *A. acutus*.

Aetideus armatus (Boeck)

(Fig. 23, *a–i*)

Aetideus armatus Sars, 1903, p. 25; Esterly, 1905, p. 154; A. Scott, 1909, p. 37; Wolfenden, 1911, p. 209; With, 1915, p. 75; Sars, 1925, p. 41; Farran, 1926, p. 246; Farran, 1929, p. 228; Sewell, 1929, p. 99; Wilson, 1932, p. 45; Jespersen, 1934, p. 52; Farran, 1936, p. 87; Mori, 1937, p. 38; Wilson, 1950, p. 159; Brodsky, 1950, p. 143.

Publ. Seto Mar. Biol. Lab., VI (1), 1957. (Article 3)

Female. Length, 1.82 mm: cephalothorax, 1.43 mm; abdomen, 0.39 mm. In dorsal view cephalothorax moderately robust; frontal margin of head rounded, and has no median crest (fig. *a*). In lateral aspect, head is boldly arched (fig. *b*); rostrum consists of two rather slender spines, and has a knob at the middle of the base. Last thoracic segment ends in two acute spines which are more slender than those figured by previous authors.

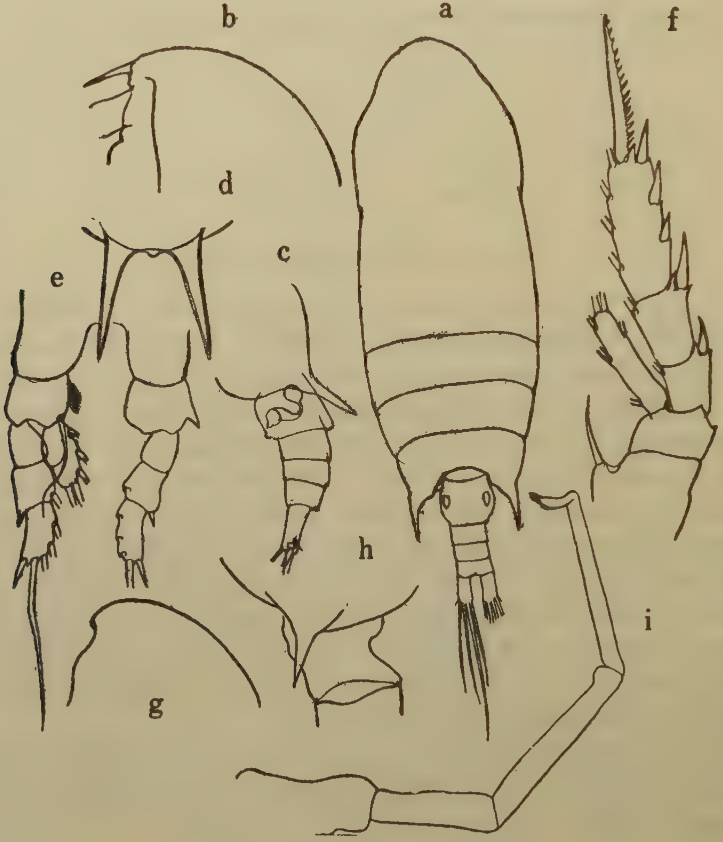

Fig. 23. *Aetideus armatus* (BOECK).

a, Female: dorsal aspect; *b*, head, lateral aspect; *c*, last thoracic segment and abdomen, lateral aspect; *d*, rostrum; *e*, 1st leg; *f*, 2nd leg; *g*, Male: head, lateral aspect; *h*, last thoracic segment, lateral aspect; *i*, 5th pair of legs.

Abdominal segments and furca are in the proportional lengths 35 : 16 : 14 : 12 : 23 = 100; genital segment wider than long; furcal rami 2-times as long as wide.

First antenna 23-jointed, extends to distal end of furca; joint 23 is as long as the 22nd; in A. SCOTT's figure joint 23 is shorter than the 22nd. Second antenna has exopodite about as long as endopodite. Mandible has a slender second basal joint.

First maxilla has 9 setae on outer lobe, 11 setae on exopodite, 6+3+4 setae on endopodite, 5 setae on second basal joint. Second maxilla and maxillipede as figured by previous authors.

First leg has 3–jointed exopodite and 1–jointed endopodite; in the present specimen mounted right leg is of abnormal structure; second basal joint has an outer-edge spine as shown in the figure (fig. *e*). Second leg has 3–jointed exopodite and 1–jointed endopodite; outer edge spine of second exopoddite exceeds base of proximal spine of third joint; terminal spine of exopodite has 17 teeth (fig. *f*). Third and fourth legs have each 3–jointed exopodite and endopodite; terminal spine of exopodite of third leg has 17 teeth; that of fourth leg has 13 teeth on the left and 15 on the right leg.

Male. Length, 1.80 mm: cephalothorax, 1.32 mm; abdomen, 0.48 mm. In dorsal view male has general resemblance to female; but lateral spines of last thoracic segment shorter. Rostrum much reduced, and represented by only a small knob. Abdomen 5–segented, segments and furca in proportional lengths 16 : 23 : 23 : 21 : 2 : 15 = 100; anal segment very short and almost concealed beneath the preceding; furcal rami about 2–times as long as wide.

First antenna reaches back to middle of third abdominal segment; joints with following proportional lengths:

Joint	1	2	3	4	5	6	7	8–9–10	11	12–13	14	15	16	17	18	19	20–21	22	23	24	25
	27	45	25	24	24	27	30	66	27	57	33	45	54	57	57	72	117	60	75	69	9=1000;

joints 3, 9 and 14 have each a long seta; proximal joints have each well developed aesthetasks. Second antenna with exopodite about 1.2–times as long as endopodite.

Swimming legs as in female; end-spine of exopodite of second leg has 26 teeth, and that of third leg has 26 teeth. Right fifth leg rudimentary; left leg slender; distal joint short, and furnished with hairs along inner margin; apex of the joint carries four small spines (fig. *i*).

Occurrence. One adult female and male from Sagami in July, and one male from Suruga, December 1937, from the depth 1000 m to the surface.

Distribution. It is widely distributed in the North Atlantic, Pacific, Indian, Malayan and Chinese seas, also in the Great Barrier Reef region.

Aetideus giesbrechti (CLEVE)

Aetideus armatus GIESBRECHT, 1892, p. 213; *Aetideus giesbrechti* A. SCOTT, 1909, p. 36; WOLFENDEN, 1911, p. 209; *Euaetideus giesbrechti* G. O. SARS, 1925, p. 42; *Aetideus giesbrechti* FARRAN, 1926, p. 247; FARRAN, 1929, p. 228; FARRAN, 1936, p. 87; MORI, 1937, p. 38, pl. 16.

Female. Length, 1.98 mm: cephalothorax, 1.59 mm; abdomen, 0.39 mm.

Remarks. A. giesbrechti is distinguished from *A. acutus* by the shape of head and lower crest. The "Siboga" specimen measured 2.1 mm in female; FARRAN's specimen from New Zealand, 1.92–1.98 mm. The specimen from Izu has longer furca. WOLFENDEN's specimen is not evenly rounded on the frontal margin of the head.

Occurrence. One adult female from the surface layer of Sagami Bay, in December 1935.

Distribution. It has been recorded from the Indian Ocean, Malay Archipelago and Gulf of Guinea. The species appears to be a warm-water inhabitant.

Aetideus bradyi A. SCOTT

(Fig. 24, *a–i*)

Aetideus bradyi A. SCOTT, 1909, p. 38, pl. 5.

Female. Length, 1.46 mm: cephalothorax, 1.14 mm; abdomen, 0.32 mm. In dorsal view frontal margin of head is constricted by the base of rostrum (fig. *a*.). In lateral view crest well marked; forehead is highly chitinised (fig. *b*.). Rostrum short and strong, with divergent points; knob-like processes of inner side of the wide base are observed in trace (fig. *d*). Wing-like processes of last thoracic segment reach back to distal margin of second abdominal segment (fig. *c*).

Proportional lengths of abdominal segments and furca: 35 : 18 : 12 : 15 : 20 = 100. Furcal rami two times as long as wide; appendicular seta long (fig. *e*).

First antenna reaches back to distal margin of fourth abdominal segment; proportional lengths of joints are:

Joint	1	2	3	4	5	6	7	8–9	10	11	12	13	14	15	16	17
	28	35	21	21	24	24	26	45	21	24	28	31	42	45	52	56

	18	19	20	21	22	23	24	25
	59	66	59	54	73	75	76	14 = 1000.

Mouth parts and swimming legs have no interesting features; the number of teeth on terminal spine of exopodite of second and third legs are 15 and 13 respectively.

Male. Length, 1.40 mm: cephalothorax 1.10 mm; 0.39 mm. The specimen resembles male of *A. armatus* (fig. *f*). Forehead slightly chitinised. Rostrum is represented by a small knob-like projection when viewed from the lateral (fig. *h*). Lateral corners of last thoracic segment produced on each side into a strong spine with a basal thickening (fig. *g*).

Abdomen 5-segmented, segments and furca in proportional lengths 19 : 22 : 19 : 19 : 4 : 17 = 100. Furcal rami 1.7 times as long as wide.

First antenna 25-jointed, reaches back to distal margin of second abdominal segment; joints are in the following proportional lengths:

Joint	1	2	3	4	5	6	7	8–9–10	11	12–13	14	15	16	17
	28	33	20	20	24	24	28	65	24	61	37	45	57	61

	18	19	20–21	22	23	24	25
	61	69	107	73	77	77	8 = 1000;

these proportional lengths are quite different from those of *A. armatus*. Second antenna with exopodite about 1.1-times as long as endopodite. Outer lobe of first maxilla has 5 long setae; exopodite with 10 setae. Maxillipede has first and second basal joints and endopodite in following proportional lengths 30 : 30 : 16.

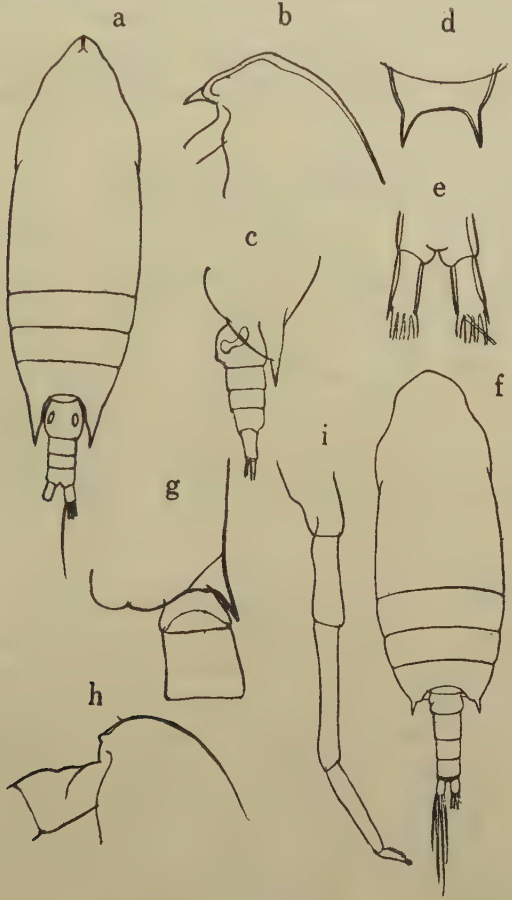

Fig. 24. *Aetideus bradyi* A. SCOTT.

a, Female : dorsal aspect ; *b*, head, lateral aspect ; *c*, last thoracic segment and abdomen, lateral aspect ; *d*, rostrum ; *e*, anal segment and furca ; *f*, Male : dorsal aspect ; *g*, last thoracic segment, lateral aspect ; *h*, head, lateral aspect ; *i*, 5th pair of legs.

Swimming legs do not show any specific character. Number of teeth on terminal spine of exopodite of second to fourth legs are 20, 19, and 16 respectively. In fifth pair of legs right one is reduced; left one is long and slender as in *A. armatus* (fig. *i*).

Remarks. The present male specimen can be distinguished from *A. armatus* in the followings: much smaller size; proportional lengths of abdominal segments, and joints of 1st antenna. Immature male specimen, measured 1.36 mm, has left fifth leg composed of three joints; right leg reduced. Shape of head resembles that of the adult female.

Occurrence. One adult female from the surface layer of Sagami in winter 1935 and an adult female and an immature male in a vertical hauls from the depth 1260 m to the surface in Suruga Bay, Dec. 1937,

Distribution. The species has been recorded only from the Malayan region. The species appears to be distributed in the warm regions of the Indo-Pacific.

Aetideus acutus FARRAN

(Fig. 25, *a–g*)

Aetideus acutus FARRAN, 1929, p. 228, fig. 5; FARRAN, 1936, p. 87.

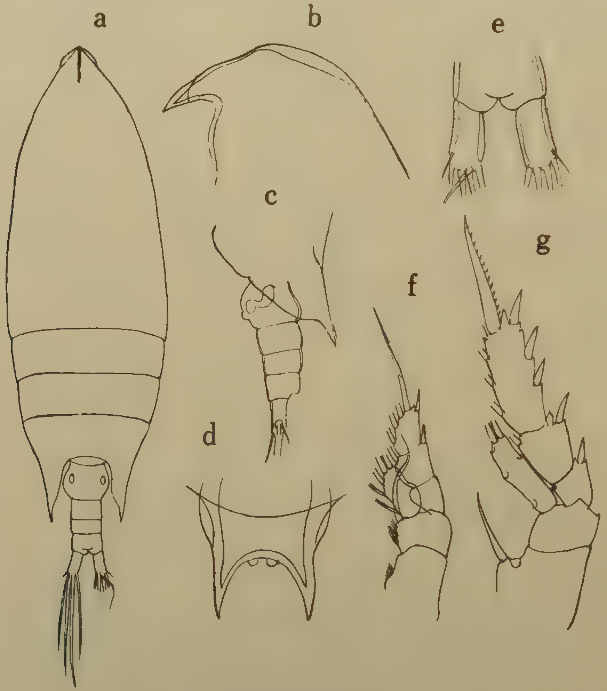

Fig. 25. *Aetideus acutus* FARRAN.
a, Female: dorsal aspect; *b*, head, lateral aspect; *c*, last thoracic segment and abdomen, lateral aspect; *d*, rostrum; *e*, anal segment and furca; *f*, 1st leg; *g*, 2nd leg.

Female. Length, 1.66 mm. Abdomen is contained 3.6-times in the length of cephalothorax. In dorsal view head contracts gradually to a blunt point and the frontal margin is constricted by wide base of rostrum (fig. *a*). In lateral view frontal margin of head has a well-marked chitinous crest which is slightly raised at the apex, but it is not so strongly arched as described and figured by Farran (fig. *b*). Rostrum is large and strongly chitinised with points directing rather straight, and has two knobs at its base (fig. *d*). Last thoracic segment well chitinised, and produced into strong points reaching to the middle of third abdominal segment (fig. *c*).

Proportional lengths of abdominal segments and furca are 34 : 18 : 13 : 13 : 22 = 100; the segments and furca well chitinised. Furcal rami 2-times as long as wide (fig. *d*). Mouth parts as those of *Aetideus giesbrechti*.

First antenna exceeds slightly distal end of furca; the joints are in proportional lengths:

Joint	1	2	3	4	5	6	7	8–9	10	11	12	13	14	15	16	17
	30	57	21	21	24	24	27	45	20	24	24	33	38	45	54	57
	18	19	20	21	22	23	24	25								
	57	63	57	54	68	71	74	15=1000.								

Number of serration on terminal spine of exopodite of second to fourth legs are 15, 16 and 14 respectively. First and second legs as shown in the figures (fig. *f*, *g*).

Remarks. The species comes very near to *A. giesbrechti*, but differs from it in the shape of forehead both in dorsal and lateral aspects, in the proportional lengths of abdominal segments and furca, and also in the proportional lengths of joints of first antenna. The crest in lateral view is less prominent than that of *A. bradyi*.

Occurrence. The species is rather common both in the surface and deep waters.

Distribution. The species has been recorded from New Zealand and the Great Barrier Reef.

Genus *Aetideopsis* G. O. Sars, 1903

From the Malayan region only one species of this genus has, up to the present time, been reported: *Aetideopsis multiserrata* (Wolfenden) (=*Aetideopsis rostrata* A. Scott). I have found in the collection the same species and other two species which appear to be yet undescribed. The genus differs from *Aetideus* in the following: head and first thoracic segment completely or incompletely fused; last thoracic segment separates from the fourth; first antenna 24-jointed, joints 8 and 9 are fused; mouth parts as in *Aetideus*; first leg has an outer edge-spine on first joint of exopodite; first basal joint is furnished with spinules on the outer margin, and bristles on the inner margin; second leg has 2-jointed endopodite, first basal joint is furnished with groups of spinules on the outer proximal margin. Fifth leg absent in female. Male resembles female in general appearance; fifth pair of legs are of about equal lengths on each side with three free joints of exopodite attached to the 2-jointed basals; the endopodite rudimentary.

Aetideopsis multiserrata (Wolfenden)

(Fig. 26, *a–m*)

Faroella multiserrata Wolfenden, 1904, p. 117; Farran, 1908, p. 29; *Aetideopsis rostrata* A. Scott, 1909, p. 81; *Chiridius nasutus* With, 1915, p. 81; *Aetideopsis multiserrata* Sars, 1925, p. 43; *Chiridius multiserrata* Farran, 1926, p. 248; *Aetideopsis multiserrata* Jespersen, 1934, p. 53; Brodsky, 1950, p. 146.

Female. Length, 3.13 mm: cephalothorax, 2.38 mm; abdomen, 0.75 mm; so abdomen is contained about 3.2–times in length of cephalothorax. Body slender; the greatest width is about one-third the length of cephalothorax. Last two thoracic segments are separate. Lateral corners of last thoracic segment produced into a strong spine on each side, reaching the middle of genital segment (fig. *a*, *b*). Rostrum highly chitinised and very prominent. The shape in lateral view differs somewhat from the figure given by SARS or A. SCOTT; it directs anteriorly, hollowing at base; external margin of rostrum are not so concave, as figured by A. SCOTT (fig. *f*).

Abdomen 4-segmented, segments and furca are in proportional lengths, 35 : 24 : 17 : 10 : 14 = 100. Genital segment produced moderately below (fig. *c*). Furcal rami about as long as wide; furcal setae slender (fig. *e*).

First antenna reaches back to distal margin of second abdominal segment; proportional lengths of joints are as follows:

Joint	1	2	3	4	5	6	7	8–9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
	35	63	29	24	29	29	31	59	29	29	29	31	38	42	45	45	45	66	70	45	38	66	63	20=1000;

posterior seta of 23rd joint extends beyond distal margin of the 25th. Second antenna with exopodite about 1.3–times as long as endopodite. Mandible shows no characteristic features. Outer lobe of 1st maxilla with 8 setae, exopodite with 10 setae. Second maxilla and maxillipede as figured by A. SCOTT.

First leg has 3–jointed exopodite and 1–jointed endopodite; joints of exopodite are broad; first basal joint carries a group of spinules on the outer margin about middle (fig. *g*). Terminal spine of second to fourth legs have 40, 36, and 40 teeth respectively. Second leg as shown in the figure.

Male. Length, 3.04 mm: cephalothorax, 2.25 mm; abdomen, 0.79 mm. Head fused with first thoracic segment (fig. *j*). Line of fusion between fourth and fifth thoracic segments scarcely visible in dorsal aspect (fig. *i*). Base of lateral process of last thoracic segment moderately inflated (fig. *l*). Branches of rostrum closely set together.

Abdomen 5–segmented, segments and furca in proportional length 16 : 34 : 23 : 16 : 1 : 10 = 100. Furcal rami 1.4–times as long as wide. Second to fourth segments are fringed with fine teeth on the distal margin.

First antenna extends to distal end of second thoracic segment; joints are in proportional lengths:

Joint	1	2	3	4	5	6	7	8–9–10	11	12	13	14	15	16	17	19	20	21	22	23	24	25
	42	61	28	28	33	33	38	113	38	38	38	38	42	42	39	42	52	52	52	52	46	14=1000.

Second antenna with exopodite little longer than endopodite; first basal joint has rows of hairs on the posterior surface. Mandible not characteristic. In first maxilla first

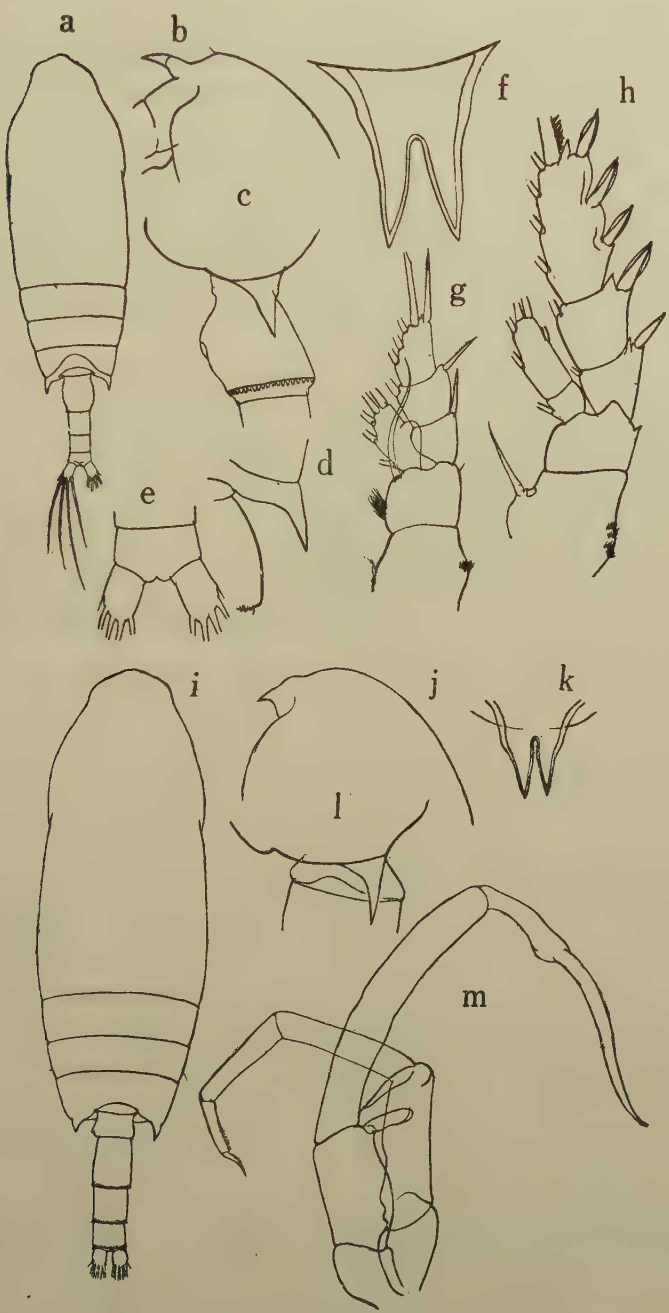

Fig. 26. *Aetideopsis multiserrata* Wolfenden.

a, Female: dorsal aspect; *b*, head, lateral aspect; *c*, last thoracic segment and genital segment, lateral aspect; *d*, last thoracic segment, dorsal aspect; *e*, anal segment and furca, dorsal aspect; *f*, rostrum; *g*, 1st leg; *h*, 2nd leg; *i*, Male: dorsal aspect; *j*, head, lateral aspect; *k*, rostrum; *l*, last thoracic segment, lateral aspect; *m*, 5th pair of legs.

outer lobe has 6 long and 3 short setae, and a rounded swelling on outer margin when viewed in posterior aspect; spinulation of various parts as follows: exopodite, 9 setae; endopodite, 11 setae; second basal joint, 4 setae; third inner lobe, 3 setae; first and second inner lobe have each rudimentary sensory setae. Maxillipede has a slender second basal joint.

In first leg outer-edge spine of joints of exopodite rather short when compared with those of adult female or immature male. Second leg with 2-jointed endopodite; terminal spine of exopodite with 40 teeth; first basal joint with fine spinules on the outer margin. Third and fourth legs broken off. Fifth pair of legs resemble those of *Aetideopsis minor* WOLFENDEN (fig. *m*).

Remarks. Shape of rostrum, lateral process of last thoracic segment, and proportional lengths of joints of first antenna distinguish the present specimen from *Aetideopsis minor* WOLFENDEN. VERVOORT (1950) described a new species, *Aetideopsis trichechus*. He is convinced that his species is identical with *A. rostrata* A. SCOTT. But his specimen differs from the latter in the shape of rostrum, and in the proportional lengths of outer-edge spine of joints of exopodite of first leg.

Occurrence. Three adult females and one male from Suruga, July 1937; fourty three females and three males from Sagami, November 1937, from the depth 1000 m to the surface.

Distribution. Recorded from the North Atlantic and Malayan region.

Aetideopsis divergens sp. nov.

(Fig. 27, *a–j*)

Female. Length, 3.01 mm: cephalothorax, 2.35 mm; abdomen, 0.66 mm; so abdomen is contained 3.5-times in the length of cephalothorax. Cephalothorax about 2.6-times as long as it is wide at first thoracic segment. Posterior spines of last thoracic segment wider but shorter when compared with those of the preceding species. Articular membrane between head and first thoracic segment is observed both in dorsal and lateral aspects. Integuments finely granulated (fig. *a*, *b*, *c*). Rostrum stout, bifurcate and strongly divergent (fig. *d*).

Abdomen 4-segmented, segments and furca with proportional lengths 38 : 19 : 16 : 11 : 16 = 100. Genital segment about as long as wide. Furcal rami little longer than wide (6 : 5), and slightly divergent.

First antenna 24-jointed, extends to distal margin of third abdominal segment: joints with following proportional lengths:

Joint	1	2	3	4	5	6	7	8–9	10	11	12	13	14	15	16	17
	34	60	24	30	27	27	30	60	27	27	27	37	37	47	47	50
	18	19	20	21	22	23	24	25								
	43	63	70	43	53	63	63	20 = 1000.								

Second antenna with exopodite about 1.3-times as long as endopodite. Mandible, maxilla, and maxillipede as those of *A. rostrata* SARS.

In first leg outer edge spines of exopodite long and slender (fig. *e*). Joints of endopodite of second leg are incompletely separate; articular membrane clearly seen on the posterior surface. Terminal spines of second to fourth legs have 58, 45, and 40 teeth respectively; the teeth are partially fused on its basal part by a sort of lamella.

Male. length, 3.13 mm: cephalothorax, 2.25 mm; abdomen 0.98 mm. Body oblong ovate. Cephalothorax 2.5-times as long as it is wide at first thoracic segment. Head and first thoracic segment completely fused; fourth and fifth thoracic segments are partially fused; the line of fusion faintly visible in dorsal aspect, thoracic segments finely granulated (fig. *f*, *g*). Rostrum divergent, pointing forwards (fig. *h*).

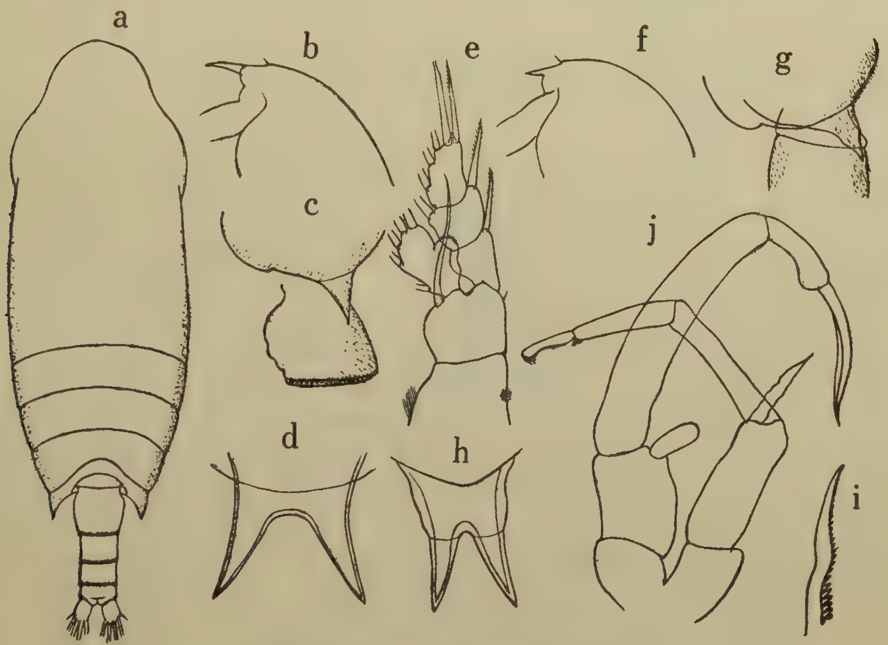

Fig. 27. *Aetideopsis divergens* sp. nov.

a, Female: dorsal aspect; *b*, head, lateral aspect; *c*, last thoracic segment and genital segment, lateral aspect; *d*, rostrum; *e*, 1st leg; *f*, Male: head, lateral aspect; *g*, last thoracic segment, lateral aspect; *h*, rostrum; *i*, terminal spine of exopodite of 2nd leg; *j*, 5th pair of legs.

Abdomen 5-segmented, proportional lengths of segments and furca are 12:31:25:18:2:12=100. Anal segment concealed beneath the foregoing. Furcal rami about as long as wide.

First antenna reaches back to distal margin of second thoracic segment; proportional lengths of joints as follows:

Joint	1	2	3	4	5	6	7	8–9–10	11	12	13	14	15	16	17
	40	70	30	30	34	34	34	104	34	30	35	35	40	40	40

Joint	18	19	20	21	22	23	24	25
	45	60	60	45	50	50	45	15=1000.

Second antenna strong; exopodite about as long as endopodite. Mandible and second maxilla reduced. Maxillipede with long basal joints; fourth joint of endopodite produced anteriorly.

In first leg outer edge spine of exopodite rather short; inner margin of second basal joint smooth. Second leg with 48 teeth on the terminal spine of exopodite; the terminal spine is deformed as shown in the figure (fig. *i*). Third leg missing. Fourth leg has 42 teeth on terminal spine of exopodite. Fifth pair of legs as in *Chiridius armatus* (Boeck); endopodite rudimentary (fig. *j*).

Immature male measured 2.7 mm. First antenna extends to distal margin of third abdominal segment. First leg resembles that of the adult female.

Remarks. The specimens agree with *Aetideopsis minor* Wolfenden, except for divergent rostrum and somewhat short furca. *A. minor* has the furca which is about 2-times as long as wide; Farran's specimen of the same species (2.92–3.25 mm) from the Antarctic has furcal rami 1.5–times as long as wide. Endopodite of second leg is, according to Wolfenden, 3–jointed, but it is 2–jointed in Farran's specimen. *A. minor* Wolfenden (*Chiridius minor* Farran) has been recorded only from the Antarctic. The present specimens were collected in the vertical hauls 1000–800 m, 1000–600 m, 200–0 m, and 100–0 m. It is unreasonable that the Antarctic species has so wide a distribution in the upper layers of the North Pacific. Shape of rostrum and structure of furcal rami are different from those of the Antarctic specimen. The present specimen differs from either of *A. pacifica* and *A. divaricata* described by Esterly.

Occurrence. Six adult females and one male in all from deep waters of both Sagami and Suraga.

Aetideopsis cristata sp. nov.

(Fig. 28, *a–m*)

Female. Length, 3.84 mm: cephalothorax, 2.94 mm; abdomen, 0.90 mm; so abdomen is contained 3.26–times in length of cephalothorax. Head with chitinised median crest, separates from 1st thoracic segment. Last two thoracic segments separate; last thoracic segment produced posteriorly into spines which extend to more than two-thirds of genital segment. Integument finely granulated (fig. *a*, *b*, *c*). Rostrum very strong, with a wide base; rami straight and parallel (fig. *d*).

Abdomen 4–segmented, segments and furca with proportional lengths: 25 : 23 : 19 : 14 : 19 = 1000. Genital segment produced below. Furcal rami 1.3–times as long as wide.

First antenna extends to distal margin of 3rd abdominal segment; proportional lengths of joints as follows:

Joint	1	2	3	4	5	6	7	8–9	10	11	12	13	14	15	16	17
	41	60	24	24	28	28	28	58	24	24	24	36	39	45	47	50

	18	19	20	21	22	23	24	25
	45	61	69	45	53	66	64	16=1000.

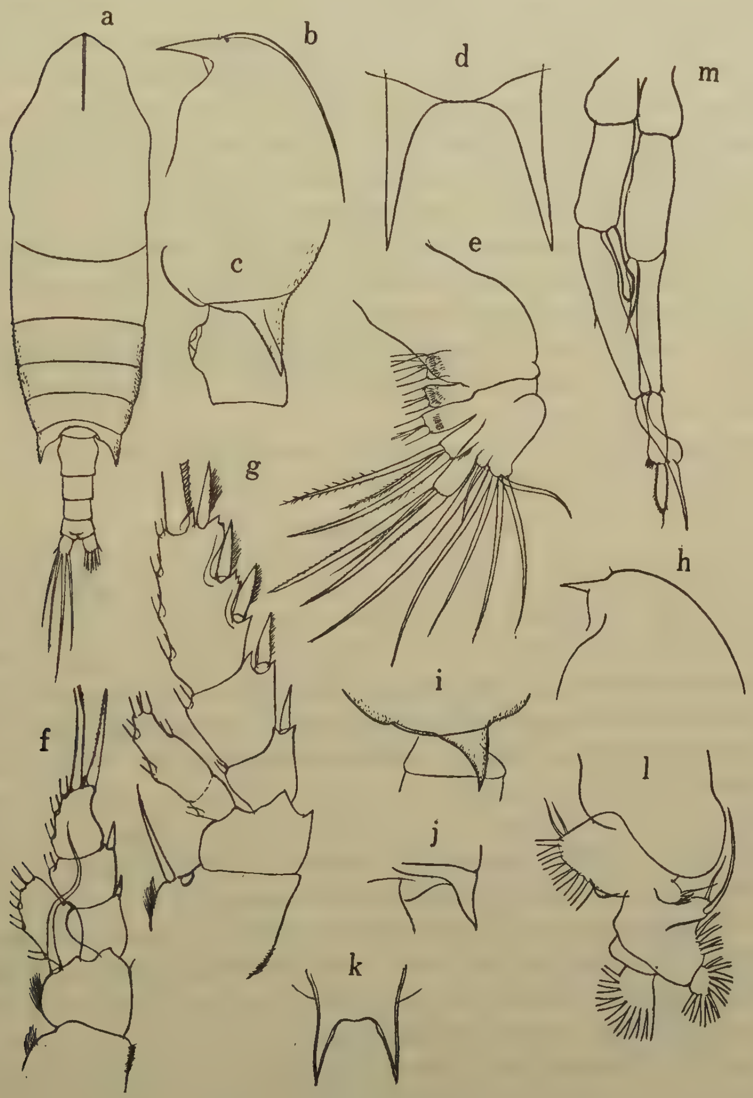

Fig. 28. *Aetideopsis cristata* sp. nov.

a, Female: dorsal aspect; *b*, head, lateral aspect; *c*, last thoracic segment and genital segment, lateral aspect; *d*, rostrum; *e*, 2nd maxilla; *f*, 1st leg; *g*, 2nd leg; *h*, Male: head, lateral aspect; *i*, last thoracic segment; lateral aspect; *j*, last thoracic segment, dorsal aspect; *k*, rostrum; *l*, 1st maxilla; *m*, 5th pair of legs.

Second antenna with exopodite about 1.2–times as long as endopodite. First maxilla with 7 long and 2 short setae on first outer lobe; second outer lobe without seta; exopodite with 10 setae; second basal with 5 setae; endopodite with 4+3+6 setae; first inner lobe with 14 setae; second inner lobe with 5 setae; third lobe with 4 setae. Second maxilla and maxillipede as those of the preceding species (fig. *e*).

In first leg outer edge spine of first and second joints of exopodite short, not reaching the middle of the next (fig. *f*). Second leg has articular membrane between first and second joints on anterior surface of endopodite (fig. *g*). Terminal spine of exopodite of second to fourth legs have 27, 32 and 40 teeth respectively.

Male. Length, 3.25 mm: cephalothorax 2.55 mm; abdomen, 0.97 mm; so abdomen is contained 2.7–times in length of cephalothorax. Head and first thoracic segment completely fused; fourth and fifth thoracic segments incompletely articulated. Posterior margin of last thoracic segment produced into spines extending to distal margin of first abdominal segment (fig. *h*). Integument finely granulated. Rostrum strong, slightly divergent, and has a wide base (fig. *k*).

Abdominal segments and furca with proportional lengths 12 : 30 : 24 : 19 : 2 : 13 =100; second to fourth segments are fringed with fine teeth on the distal margin. Furcal rami 1.4–times as long as wide.

First antenna extends to distal margin of second thoracic segment; proportional lengths of joints are as follows:

Joint	1	2	3	4	5	6	7	8–9–10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
	54	54	31	31	31	36	36	72	31	32	41	36	45	45	45	45	58	58	45	49	58	54	13=1000;

joints 9 and 10 are fused on the posterior margin. Second antenna with exopodite about as long as endopodite. Mandible with a rounded second basal joint; exopodite about as long as endopodite. Maxilla with 9 setae on outer lobe; 9 setae on exopodite (fig. *l*). Second maxilla much reduced. Second basal joint of maxillipede a little longer than first.

First to fourth swimming legs as in the female. Terminal spine of exopodite of second to fourth legs with 31, 34 and 36 teeth respectively.

Fifth pair of legs as those of *Chiridius armatus* (BOECK) figured by SARS (fig. *m*).

Remarks. The present specimen differs from the other member of the genus in the followings: shape of rostrum; forehead with median crest; short outer edge spine of first and second joints of exopodite of first leg.

Occurrence. 118 females and 4 males from Sagami in the vertical hauls from the depth 1000 m to the surface, Nov. 1937.

Genus *Undinopsis* G. O. SARS, 1884

(*Bradyidius* GIESBRECHT)

The genus comprises, at present three species, *Undinopsis bradyi* Sars (=*Bradyidius armatus* Giesbrecht), *U. tropicus* Wolfenden and *U. stimilis* Sars. A single specimen belonging to the genus was found in the collection, which appears to be different from those hitherto been described. The generic characters are as follows: head fused with first thoracic segment; fourth and fifth thoracic segments are fused; rostrum terminates into strong bifurcate points; last thoracic segment ends in acute expansions; abdomen of female 4-jointed; first antenna 24-jointed; mouth parts as those of *Aetideus*; first leg with 3-jointed exopodite and 1-jointed endopodite; joints of exopodite bears each an outer edge spine; second leg with 3-jointed exopodite and 2-jointed endopodite; third and fourth legs with 3-jointed exopodite and endopodite; endopodite of second to fourth legs are furnished with groups of minute spinules. Fifth leg absent in female. Sars recorded the occurrence of *Undinopsis bradyi* from the Norwegian Sea. Wolfenden, A. Scott, and Farran recorded the tropical species *U. tropicus* Wolfenden from the Maldive Archipelago, Malay Archipelago and Great Barrier Reef area respectively. From Japanese waters Mori reported *U. bradyi* under the name *Bradyidius armatus* (Brady). It is said that *U. bradyi* and *U. tropicus* differ only in size and in minute points of structure.

Undinopsis angustus sp. nov.

(Fig. 29, *a*–*i*)

Male. Length, 1.37 mm: cephalothorax, 1.03 mm; abdomen, 0.34 mm; so abdomen is contained 3-times in the length of cephalothorax. Cephalothorax moderately robust; the greatest width less than half the length of cephalothorax. Head fused with first thoracic segment, so are the fourth with the fifth (fig. *a*). Posterior margin of last thoracic segment produced into acute spines extending beyond distal margin of first abdominal segment (fig. *c*). Rostrum strong, curved somewhat posteriorly at the apex (fig. *b*).

Abdomen 5-segmented, segments and furca with proportional length 14:32:19:19:3:13=100; second to fourth segments are fringed with fine teeth on the distal margin. Furcal rami 1.3-times as long as wide.

First antenna extends to distal margin of second abdominal segment; joints are in the following proportional length:

Joint	1	2	3	4	5	6	7	8–9–10	11	12–13	14	15	16	17	18	19	20	21	22	23	24	25
	24	36	20	20	24	28	32	82	28	73	41	49	49	53	56	65	61	56	65	65	61	12=1000;

joints 20 and 21 are fused on the right. Second antenna with exopodite about as long as endopodite (fig. *e*). Second maxilla much reduced. Maxillipede has a large second joint of endopodite.

First leg has on first joint of exopodite a short outer edge spine; third joint of exopodite has also a short outer edge spine; first basal joint with fine spinules on the outer margin (fig. *f*). Second leg has 2-jointed endopodite; second joint of endopodite has three groups of spinules on the posterior surface; terminal spine of the exopodite has 24 teeth on the left, 22 teeth on the right (fig. *g*). Third and fourth legs with 3-jointed endopodite; second and third joints of endopodite are furnished with groups of minute spinules on posterior surface (fig. *h*); terminal spine of exopodite of third leg with 25 teeth, and that of fourth with 27 teeth.

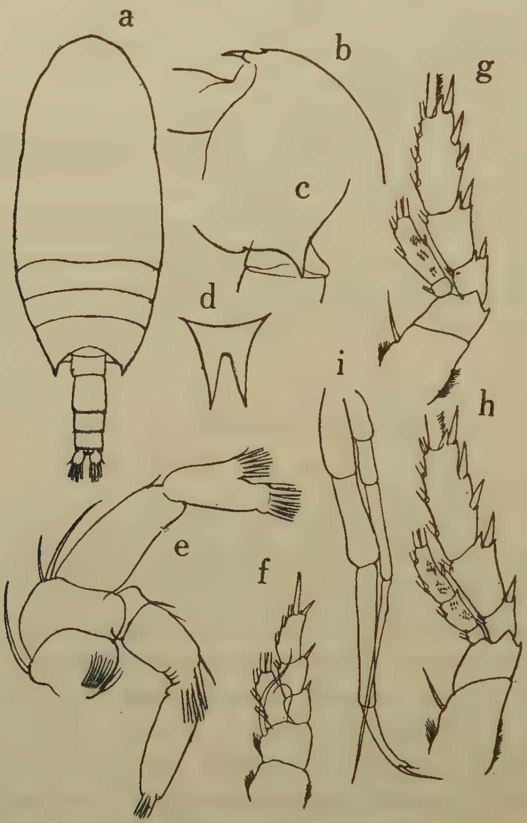

Fig. 29. *Undinopsis angustus* sp. nov.
a, Male: dorsal aspect; *b* head, lateral aspect; *c*, last thoracic segment, lateral aspect; *d*, rostrum; *e*, 2nd antenna; *f*, 1st leg; *g*, 2nd leg; *h*, 4th leg; *i*, 5th pair of legs.

Fifth pair of legs resemble those of male of the genus *Chiridius* (fig. *i*).

Remarks. The tropical specimen of *Undinopsis*, taken in the "Siboga", measured 1.7 mm, the specimen from the Maldive, 1.2 mm, and that from the Great Barrier Reef region, 1.5–1.63 (female) and 1.26–1.28 (male) mm. The Maldive specimen for which

WOLFENDEN proposed *U. tropicus*, differs from the northern species only in size and in the number of teeth on terminal spine of exopodite of second to fourth legs. MORI reported the occurrence of a female of *U. bradyi* from the neighbouring waters of Japan. His specimen is not identical with *U. bradyi*; the specimen has the thoracic spines not reaching the middle of genital segment; in first leg outer marginal spine of first joint of exopodite wanting; the specimen appears to be a member of *Gaidius*. The present specimen is close, in size, to the tropical specimen of *Bradyidius armatus* recorded by A. SCOTT, or to *Unidinopsis tropicus* recorded by WOLFENDEN and by FARRAN. If *U. bradyi*, the northern species, would have been distinct from *U. tropicus*, the tropical species, only in having coarse teeth on terminal spine of exopodite of second to fourth legs, the present specimen is not identical with *U. bradyi*, in having the male fifth legs differ from those of *U. bradyi* figured by SARS. FARRAN described the male of *U. tropicus* only on size without giving any figures. I propose to give to the present specimen a new name *U. angustus*.

Occurrence. One male from Sagami and two males from Suraga in the vertical hauls from the depth 1000 m to the surface, 1937.

Genus *Chiridius* GIESBRECHT, 1892

The following species have been recorded from various regions of the oceans: *Chiridius gracilis* FARRAN, *Ch. poppei* GIESBRECHT, *Ch. obtusifrons* SARS, *Ch. modestus* WITH, *Ch. polaris* WOLFENDEN, *Ch. minor* WOLFENDEN, *Ch. antarcticus* (WOLFENDEN) and *Ch. armatus* (BOECK). The genus has, according to GIESBRECHT's original description, the following characters: general appearance as in *Aetideus*, but rostrum absent; endopodite of second antenna about half the length of exopodite; endopodite of mandible very short. According to his definition the following five species are comprised in *Chiridius* in its restricted sense: *Ch. gracilis*, *Ch. poppei*, *Ch. obustifrons*, *Ch. modestus* and *Ch. polaris*. FARRAN included both rostrate and arostrate species in the same genus *Chiridius* from the reason that presence or absence of rostrum does not seem to be sufficient to separate generically the species which, in other respects, resemble closely each other. He added *Chiridius armatus* (BOECK), *Faroella minor* WOLFENDEN (=*Aetideopsis minor* (WOLFENDEN)) and *Faroella antarcticus* WOLFENDEN (=*Aetideopsis antarcticus* WOLFENDEN) into *Chiridius*. Here the genus *Chiridius* in wide sense comprises four genera, namely *Chiridius* GIESBRECHT, *Undinopsis* SARS, *Aetideopsis* SARS and *Faroella* WOLFENDEN. They resemble, indeed, each other in the structure of swimming legs, viz. first leg with 3-jointed exopodite and 1-jointed endopodite, and joints of exopodite have each an outer edge spine; second leg with 3-jointed exopodite and 2-jointed endopodite, though there are some exception in incomplete segmentation of joints of endopodite; third and fourth legs with 3-jointed exopodite and endopodite. Then, why does FARRAN not included

Undinopsis SARS in his wide-sensed *Chiridius*? The genus *Undinopsis* differs from the members of *Chiridius* only in the armature on the posterior surface of joints of endopodite of second to fourth legs. GIESBRECHT defined as generic characters of *Chiridius*, beside the absence of rostrum, short endopodite of second antenna and mandible. In *Aetideopsis* and, perhaps, *Faroella*, endopodite of mandible is not small at all; in *Chiridius* SARS (*Pseudoaetideus* WOLFENDEN) endopodite of second antenna is about half the length of exopodite. These three genera, *Aetideopsis*, *Faroella* and *Chiridius* GIESBRECHT resemble each other in general appearance and in the structure of swimming legs with exception of the structure of second antenna and mandible. Absence or presence of rostrum is, by no means, insufficient reason of separating generically species. FARRAN himself distinguishes arostrate and rostrate species in his wide-sensed *Chiridius*. It seems reasonable, for the present, to follow GIESBRECHT's definition of the genus *Chiridius*.

In the present collection five species have been detected of which two have been described, and the remaining three undescribed. Male specimens of this genus resemble so closely each other, differing only in size and in minute points of structure, that it is troublesome to connect them to the corresponding females.

Chiridius gracilis FARRAN

(Fig. 30, *a–e*)

Chiridius gracilis FARRAN, 1908, p. 30; A. SCOTT, 1909, p. 42; WOLFENDEN, 1911, p. ; WITH, 1915, p. 75; FARRAN, 1929, p. 229; FARRAN, 1936, p. 87; TANAKA, 1937, p. 225, fig. 6.

Female. Length, 2.55 mm. Posterior spines of last thoracic segment not divergent. In some specimens thoracic spines show a slight basal thickening, as figured by FARRAN (1929). Endopodite of second leg has a trace of segmentation between first and second joints on the anterior surface. Terminal spine of exopodite of fourth leg has 22 teeth. My previous specimen (1937) had 24, 28 and 26 teeth on the terminal spine of exopodite of second to fourth legs respectively. Fifth leg absent in female.

Male. Length, 2.32 mm: cephalothorax, 1.68 mm; abdomen, 0.64 mm. Cephalothorax oblong ovate, the greatest width 0.65 mm (fig. *a*). Lateral spines of last thoracic segment stout, with a wide base; last two thoracic segments completely fused (fig. *c*). Rostrum is represented by a thin triangular plate.

Abdomen 4-segmented, segments and furca with proportional lengths 18 : 26 : 25 : 17 : 2 : 12 = 100; furcal rami about 1.3-times as long as wide. Second to fourth segments are fringed with fine teeth on the distal margin.

First antenna 23-jointed, extends to distal margin of last thoracic segment; joints are in the proportional lengths:

Joint	1	2	3	4	5	6	7	8–9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24–25	
	35	45	23	23	26	26	29	63	29	29	35	35	35	45	45	52	52	59	63	46	60	60	75	=1000.

Second antenna with exopodite about 1.4–times as long as endopodite; first basal joint with a row of hairs on the posterior surface. Mandible with short endopodite. First maxilla with 5 setae on outer lobe; 9 setae on exopodite; 9 setae on endopodite; first inner lobe with aesthetask-like filaments. Maxillipede slender; fifth joint of endopodite with a characteritic setae, as shown in the figure (fig. *e*).

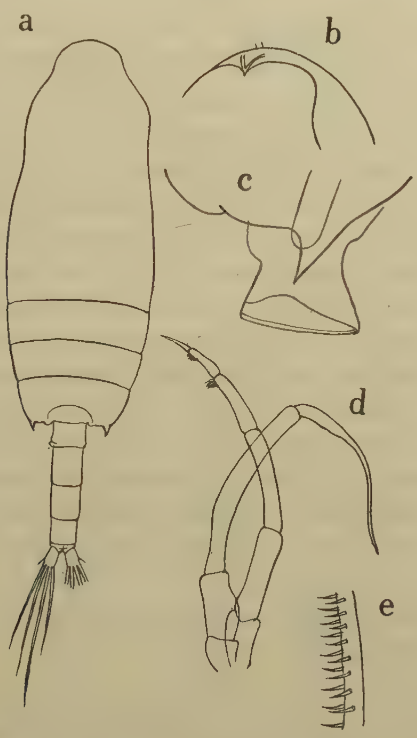

Fig. 30. *Chiridius gracilis* FARRAN.
a, Male: dorsal aspect; *b*, head, anterior aspect; *c*, last thoracic segment, lateral aspect; *d*, 5th pair of legs.

First leg with 3–jointed exopodite. Second leg with 2–jointed endopodite; terminal spine of exopodite has 28 teeth. Third and fourth legs with 3–jointed endopodite; terminal spines of exopodite of the same legs with 30 and 28 teeth respectively. Fifth pair of legs slender, resemble those of *Ch. obtusifrons* SARS; right leg about as long as second swimming leg; left leg short, about four-fifths the length of right leg.

Occurrence. Eight females from Suruga, July, 1937, 35 females and two males from Sagami, Nov. 1937, from deep waters.

Distribution. The species is widely distributed in the deep waters of the Pacific, Atlantic, Indian, Malay Archipelago.

Chiridius poppei GIESBRECHT

(Fig. 31, *a–f*)

Chiridius poppei GIESBRECHT, 1892, p. 224, t. 14, 36; A. SCOTT, 1909, p. 41; FARRAN, 1929, p. 229; JESPERSEN, 1934, p. 55; TANAKA, 1937, p. 254; BRODSKY, 1950, p. 152.

Female. Length, 1.83–1.87 mm. Terminal spine of exopodite of second and third legs slightly longer than third joint of exopodite of the corresponding legs. Serration of terminal spines are straight and rather coarse. Fifth leg absent in female.

Male. Length, 1.52 mm: cephalothorax 1.11 mm; abdomen, 0.41 mm. Abdomen is contained 2.7–times in the length of cephalothorax. Cephalothorax robust; oral part of head much dilated in dorsal view. Head fused with first thoracic segment, and so are the fourth with the fifth (fig. *a*). Last thoracic segment produced into a small spine on each side; the spine is slender and convergent, bent posteriorly in the right angle to the ventral margin of last thoracic segment (fig. *d*). Rostrum short and one-pointed, rounded at the apex, directing downwards; in lateral view rostrum looks like beak; there is no trace of median crest (fig. *b*).

Abdomen 5–segmented, and furca with proportional lengths 20 : 26 : 20 : 18 : 2 : 14 =100. Anal segment very short, concealed beneath the foregoing. Furcal rami 1.4–times as long as wide; furcal seta longer than the combined lengths of abdominal segments and furca.

First antenna 23–jointed, reaches back to distal and of second abdominal segment; proportional lengths of the joints:

Joint	1	2	3	4	5	6	7	8–9–10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
	38	26	19	19	23	23	23	72	30	30	34	37	45	49	57	60	72	76	53	64	68	64	19=1000.

Second antenna with exopodite 1.4–times as long as endopodite; posterior surface of first basal joint bears rows of bristles. Mandible with a very strong seta on inner proximal margin of second basal joint. First maxilla with 7 setae on outer lobe, 9 setae on exopodite, 9 setae on endopodite. Second maxilla reduced. Maxillipede with second basal joint 1.25–times as long as the first basal; two proximal setae on anterior margin of second basal are fine and short.

First leg with a very short outer edge spine on first joint of exopodite (fig. *e*). In second leg articular membrane between first and second joints of endopodite is observed on the anterior surface; terminal spine of exopodite has 27 teeth. Third leg has 3-jointed endopodite; terminal spine of exopodite with 25 teeth. Fourth leg slender; terminal spine of exopodite has 20 teeth.

In fifth pair of legs terminal joint of right leg is long and slender; left leg as long as the combined lengths of terminal spine and three joints of exopodite of fourth leg taken together (fig. *f*).

Remarks. In the male specimen small lateral spines of last thoracic segment, long fifth legs and coarse teeth on terminal spine of exopodite of second to fourth legs distinguish the species from the foregoing.

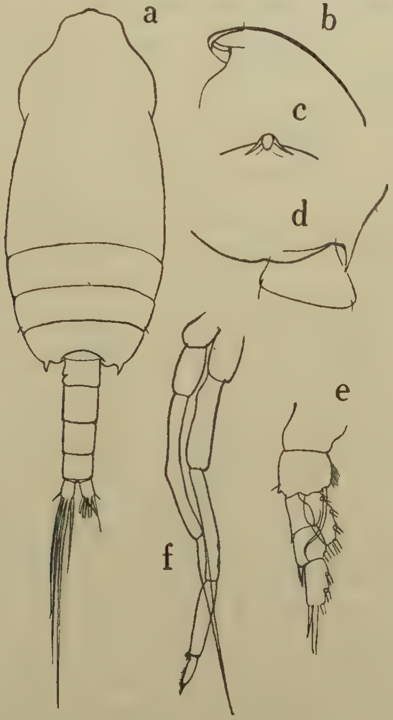

Fig. 31. *Chiridius poppei* GIESBRECHT.
a, Male: dorsal aspect; *b*, head, lateral aspect; *c*, rostrum; anterior aspect; *d*, last thoracic segment, lateral aspect; *e*, 1st leg; *f*, 5th pair of legs.

Occurrence. 16 females and one male from Sagami, and 20 females from Suruga, 1937; one male in a vertical haul from the depth 400–200 m in Suruga, Nov. 1938.

Chiridius longispinus sp. nov.

(Fig. 33, *a–h*)

Male. Length, 1.52 mm: cephalothorax, 1.14 mm; abdomen, 0.38 mm. Abdomen is contained 3-times in the length of cephalothorax. Head fused with first thoracic segment. Line of fusion between fourth and fifth thoracic segments slightly visible from the dorsal (fig. *a*). Last thoracic segment is produced into acute spines, extending beyond the end of first abdominal segment; the spines are longer and wider in proportion than in the male of *Ch. poppei* (fig. *d*). Rostrum one-pointed, beak-like in lateral view; base of rostrum well-marked in anterior aspect (fig. *b*, *c*).

Abdomen 5-segmented, segments and furca with proportional lengths 16 : 26 : 21 : 19 : 2 : 16 = 100. Furcal rami about 1.4-times as long as wide. Distal margin of second to fourth segments are fringed with fine teeth.

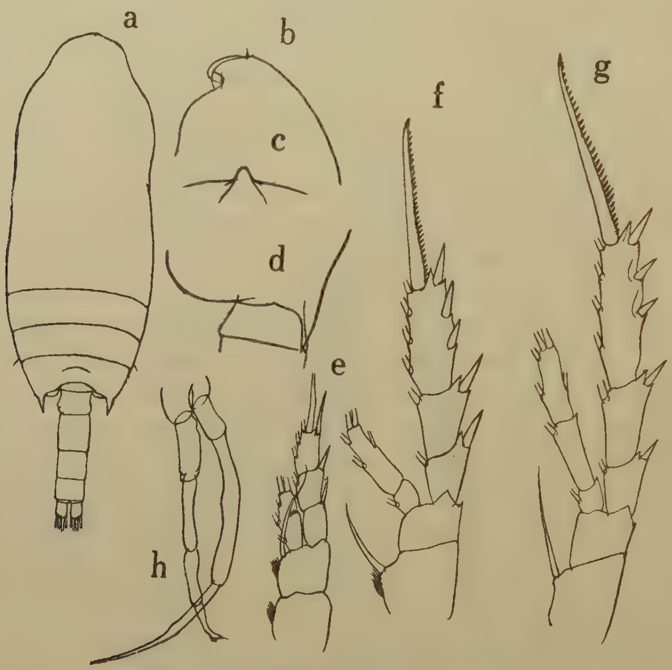

Fig. 32. *Chiridius longispinus* sp. nov.
a, Male: dorsal aspect; *b*, head, lateral aspect; *c*, rostrum, antero-dorsal aspect; *d*, last thoracic segment, lateral aspect; *e*, 1st leg; *f*, 2nd leg; *g*, 4th leg; *h*, 5th pair of legs.

Terminal joints of first antenna broken off; the remaining 18 joints with proportional lengths:

Joint	1	2	3	4	5	6	7	8–9–10	11	12	13	14	15	16	17	18	19	20–21
	9	13	8	7	7	7	8	25	8	10	11	10	12	13	14	14	17	29 = 1000;

joints 20 and 21 are fused on the right. In another specimen first antenna extends to the end of genital segment. Second antenna with exopodite 1.3-times as long as endopodite. Mandible with a short endopodite, bearing 9 setae on the distal margin. In first maxilla the spinulation of various parts as follows: outer lobe has 6 setae; exopodite has 9 setae; endopodite has 9 setae; second basal has 2 setae; third inner lobe has one seta; second inner lobe has one seta respectively. Second maxilla much reduced.

First leg has an outer edge spine on first joint of exopodite reaching about distal margin of second joint of exopodite (fig. *e*). Second leg with 2-jointed endopodite; terminal spine of exopodite long, and has 35 teeth (fig. *f*). Exopodite of third leg missing. Fourth leg has 3-jointed exopodite and endopodite; terminal spine of exopodite has 33 teeth (fig. *g*). Fifth pair of legs are short; they are shorter than half the length of fourth leg (fig. *h*).

Remarks. The present specimen resembles male of *Ch. poppei* in its small size, but slender cephalothorax, shape of thoracic spines, long terminal spines of exopodite of second to fourth legs and the proportional lengths of fifth pair of legs are different from those of the former.

Occurrence. Each an adult male both from Sagami and Suraga from the depth 1000 m to the surface, Nov. and Dec. 1937.

Chiridius molestus sp. nov.

(Fig. 33, *a*–*f*)

Male. Length, 2.04 mm: cephalothorax, 1.43 mm; abdomen, 0.61 mm. Body elongate ovate; the greatest width slightly less than half the length of cephalothorax. Head conspicuously dilated in oral region. Fourth and fifth thoracic segments fused (fig. *a*). Posterior margin of last thoracic segment with minute spines which are more convergent than those found in the male of *Ch. poppei* (fig. *c*). Rostrum as those of females of other members of the genus (fig. *b*).

Abdominal segments and furca with proportional lengths 17 : 25 : 23 : 19 : 3 : 13 = 100; furcal rami 1.5-times as long as wide.

First antenna 23-jointed, reaches back to the middle of third abdominal segment; proportional lengths of joints as follows:

Joint	1	2	3	4	5	6	7	8–9–10	11	12	13	14	15	16	17
	28	22	17	17	17	21	21	68	28	34	34	34	45	56	62

	18	19	20	21	22	23	24	25
	62	79	79	56	73	68	62	17 = 1000;

joints 20 and 21 are fused on the right side; joint 24 is incompletely separate from the 25th; proximal joints are furnished with well developed aesthetasks. Second antenna with exopodite about 1.5-times as long as endopodite. Endopodite of mandible is short, and has 8 setae. Second maxilla reduced much. Second basal joint of maxillipede is longer than the first; first joint of endopodite has 4 setae, of which the middle one is very strong.

In first leg first joint of exopodite has an outer edge spine, not reaching the end of second joint of exopodite (fig. *d*). Second leg with 1-jointed endopodite; line of fusion between first and second joints is found on the anterior surface; terminal spine of exopodite has 32 teeth (fig. *e*). Third leg with 3-jointed endopodite; terminal spine of exopodite has 29 teeth. Fourth leg slender; terminal spine of exopodite has 24 teeth. Fifth pair of legs slender, resemble those of *Ch. obtusifrons* SARS; left leg about two-thirds the length of the right; terminal joint of left leg has two unequal spines on the apex (fig. *f*).

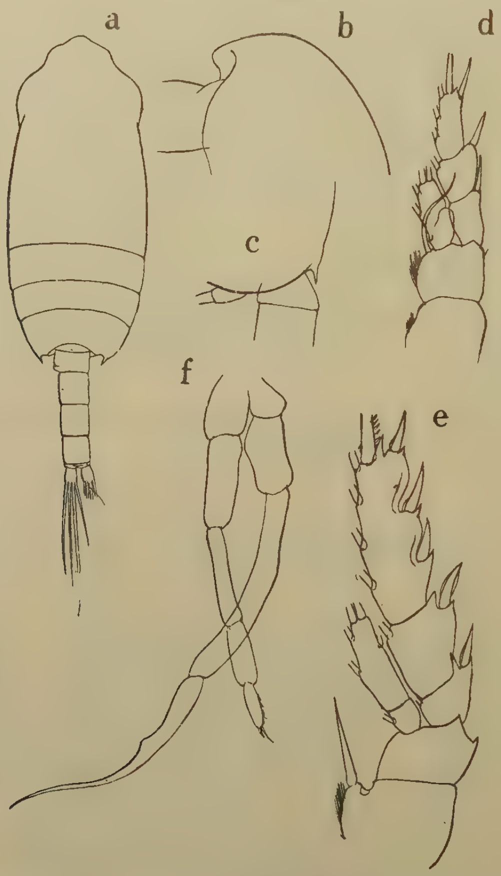

Fig. 33. *Chiridius molestus* sp. nov.
a, Male: dorsal aspect; *b*, head, lateral aspect; *c*, last thoracic segment, lateral aspect; *d*, 1st leg; *e*, 2nd leg; *f*, 5th pair of legs.

Remarks. The specimens resemble *Ch. gracilis*, but lateral spines of last thoracic segment are small.

Occurrence. Two males from Suruga, July, 1937, and three males from Sagami, Nov. 1937, in the vertical hauls from the depth 1000 m to the surface. The specimen is the richest in number among the male of the genus.

Chiridius carnosus sp. nov.

(Fig. 34, *a–f*)

Male. Length, 2.36 mm: cephalothorax, 1.77 mm; abdomen, 0.51 mm. General appearance as those of males of *Aetideus*. Cephalothorax elongate ovate. Head fused with first thoracic segment; fourth and fifth thoracic segments are incompletely fused (fig. *a*). Base of lateral spines of last thoracic segment wide (fig. *c*). Rostrum one-

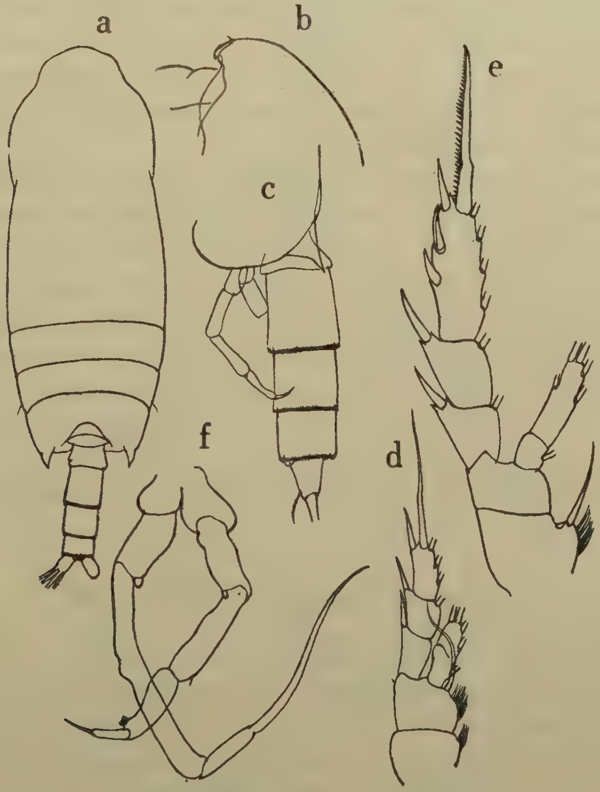

Fig. 34. *Chiridius carnosus* sp. nov.
a, Male: dorsal aspect; *b*, head, lateral aspect; *c*, last thoracic segment and abdomen, lateral aspect; *d*, 1st leg; *e*, 2nd leg; *f*, 5th pair of legs.

pointed, looks like a beak (fig. *b*).

Abdomen 5-segmented, segments and furca with proportional length 18 : 22 : 25 : 18 : 2 : 15 = 100. Anal segment very short, concealed beneath the foregoing. Furcal rami about 1.3–times as long as wide.

First antenna 23–jointed, reaches back to distal end of second abdominal segment; joints are in proportional lengths.

Joint	1	2	3	4	5	6	7	8–9–10	11	12	13	14	15	16	17
	71	47	24	19	24	28	28	96	28	28	33	33	43	47	52
	18	19	20	21	22	23	24	25							
	52	62	62	43	62	57	47	14 = 1000;							

joints 20 and 21 are fused on the right proximal joints with long aesthetasks. Second antenna with exopodite 1.25–times as long as endopodite; first basal joint has a row of long stiff hairs. Mandible has a short endopodite. First maxilla has 9 setae on endopodite, 5 setae first outer lobe, 9 setae on exopodite. Second maxilla shows no characteristic features. In maxillipede first and second basal joints, and endopodite have the proportional lengths: 35, 24 and 18.

First leg with 3–jointed exopodite; outer edge spines of the exopodite slender and long (fig. *d*). Second leg with 2–jointed endopodite; terminal spine of exopodite has 37 teeth (fig. *e*). Third leg has 3–jointed endopodite; exopodite broken off. Fourth leg broken off; first basal joint without inner marginal hairs. Ffth pair of legs resemble those of *Ch. armatus* Sars, with a very rudimentary endopodite on second basal joint on each side; distal joint of the right leg very slender and long (fig. *f*).

Remarks. The specimen appears to be a member of the genus *Chiridius*, but the structure of the fifth pair of the male legs indicates a close relationship to *Aetideopsis.*

Occurrence One male from Sagami, Nov. 1937, in the vertical haul from 1000 –0 m.

Genus *Chiridiella* G. O. Sars, 1907

Two species belonging to the genus have been detected in the collection. The genus differs from *Chiridius* in the followings: last thoracic segment has no lateral spines; exopodite of second antenna little longer than endopodite; exopodite of mandible small; first maxilla reduced; second maxilla and maxillipede very characteristic; first leg has 1–jointed endopodite; third and fourth legs with 3–jointed exopodite and endopodite, the joints of both exopodite and endopodite broad. Fifth leg absent in female. These characteristics indicate that the genus is quite a stranger among the family Aetideidae, although male fifth pair of legs show close relationship to *Gaidius* and *Gaetanus.* The systematic position remains uncetain till more species that have the similar structure in mandible and maxillae to those of this genus have been found.

Chiridiella macrodactyla G. O. SARS

(Fig. 35, *a–g*)

Chiridiella macrodactyla FARRAN, 1908, p. 46, pl. 4; A. SCOTT, 1909, p. 79, pl. 35; G. O. SARS, 1925, p. 50, pl. 16.

Female. Length, 2.57 mm: cephalothorax, 2.13 mm; abdomen, 0.44 mm. Cephalothorax ovate in outline. Head fused with first thoracic segment (fig. *a*). Last two thoracic segments fused. Rostrum absent.

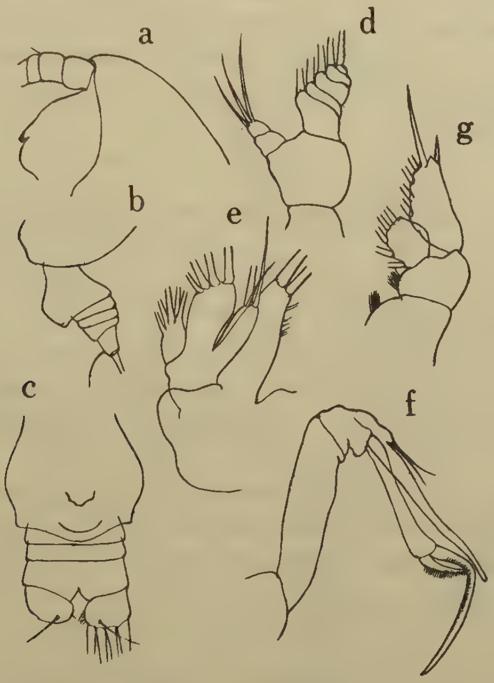

Fig. 35. *Chiridiella macrodactyla* G. O. SARS.
a, Female: head, lateral aspect; *b*, last thoracic segment and abdomen, lateral aspect; *c*. abdomen, ventral aspect; *d*, mandible palp; *v*, 1st maxilla; *f*, 2nd maxilla; *g*, 1st leg.

Abdomen 4–segmented, segment and furca with proportional lengths 40 : 12 : 12 : 12 : 20 : 16 = 100. Genital segment much wider than long, and produced considerably below. Furcal rami wider than long, carries short setae (fig. *b*, *c*).

Second antenna has 7–jointed exopodite which is 1.2–times as long as endopodite (31 : 26). Mandible simple; endopodite bears three setae on the distal joint; exopodite has five setae (fig. *d*); biting part strong and well developed. In first maxillar exopodite with five setae, endopodite with four setae, third inner lobe with three setae, first inner lobe ten setae; setae on outer lobe were not observed (fig. *e*). Second maxilla very characteristic; according to SARS, it is furnished with four lobes, among which the proximal two are simple, and each carries two setae; in the present specimen first lobe was absent; second lobe is small and has no seta; distal two lobes as those described by SARS (fig. *f*). Maxillipede slender and long; the second basal about 1.4–times as long as the first.

First leg has 1–jointed exopodite and endopodite (fig. *g*). Second leg has 3–jointed exopodite and 1-jointed endopodite. Third and fourth legs have 3–jointed exopodite and endopodite. Fifth leg absent.

Remarks. The present specimen, except minute points of difference in the structure of mandible, maxillae, agrees fairly well with the SARS' description and figures.

Occurrence. One adult female from Suruga in a haul from 1000–0 m, July, 1937.

Distribution. The species has been recorded from the deep waters of the Atlantic and Malay Archipelago.

Chiridiella brachydactyla G. O. SARS

(Fig. 36, *a–j*)

Chiridiella brachydactyla SARS, 1925, p. 51. (Female)

Male. Length, 2.36 mm: cephalothorax, 1.75 mm; abdomen, 0.61 mm. Cephalothorax oblong ovate. Head fused with first thoracic segment. Fourth and fifth thoracic segments fused (fig. *a*, *b*). Lateral corners of last thoracic segment rounded (fig. *c*).

Abdomen 5–segmented, segments and furca in the proportional lengths 27 : 21 : 15 : 18 : 6 : 15 = 100; furcal rami about as long as wide (fig. *d*).

First antenna 24–jointed, exceeds distal margin of furca by terminal two joints; joints are in the proportional length:

Joint	1	2	3	4	5	6	7	8–9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
	21	24	18	21	21	24	24	45	29	32	34	47	47	58	66	66	61	71	71	61	58	50	42	11=1000;

joints 12 and 13 are incompletely fused. Second antenna has exopodite about 1.3–times as long as endopodite; first basal joint has a tuft of hairs on the posterior surface; first joint of endopodite very voluminous (fig. *e*). Mandible has exopodite about as long as endopodite; biting part thin-skined (fig. *f*). In first maxilla outer lobe has 5 long setae, exopodite has 10 setae, endopodite and inner lobes reduced. Second maxilla reduced; fourth and fifth lobes are large, each with a strong spine at the apex (fig. *g*). Maxillipede slender; fifth lobe of first basal joint has a peculiar spine folked at the apex (fig. *h*).

First leg has 1–jointed exopodite and endopodite. Second leg with 3–jointed exopodite and 2-jointed endopodite; according to SARS, endopodite is 1-jointed in the female, but in the present male specimen line of separation between first and second joints well marked on either side of the joint, especially vivid on anterior surface; joints of exopodite broad; the terminal spine of the exopodite has 45 teeth (fig. *i*). Third and fourth legs with 3-jointed exopodite and endopodite. Fifth pair of legs resemble those of *Gaidius* (fig. *f*).

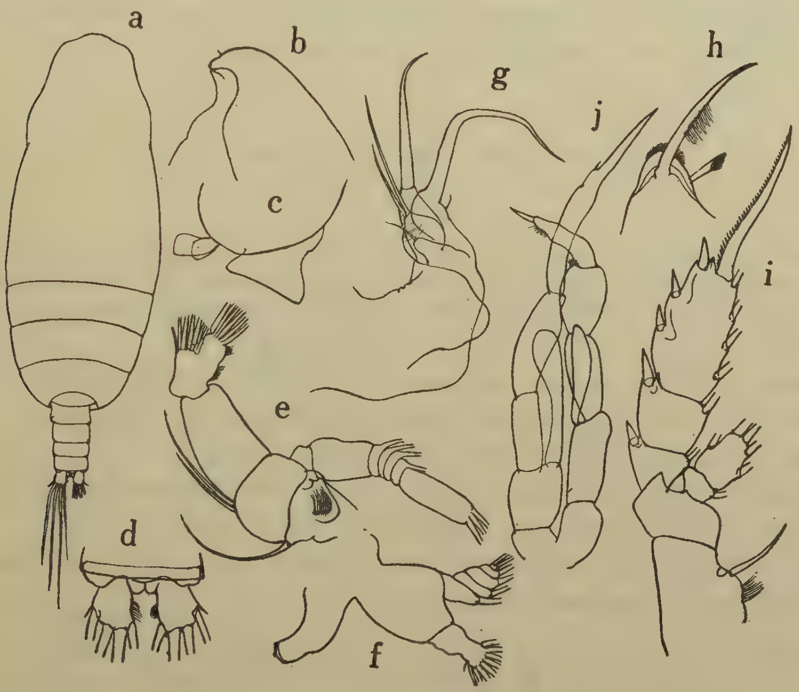

Fig. 36. *Chiridiella brachydactyla* G. O. SARS.
a, Male: dorsal aspect; *b*, head, lateral aspect; *c*, last thoracic segment, lateral aspect; *d*, anal segment and furca; dorsal aspect; *e*, 2nd antenna; *f*, mandible; *g*, 2nd maxilla; *h*, distal margin of 1st basal joint of maxillipede; *i*, 2nd leg; *j*, 5th pair of legs.

Remarks. The male specimen has not been reported before. Some authors comprises the genus *Chiridiella* in the family Euchaetidae, but SARS rightly comprised it in the family Aetideidae. The structure of male fifth pair of legs indicates that the genus is closely allied to the member of the family Aetideidae.

Occurrence. One adult male from Sagami, in a vertical haul from 1000 m to the surface, Nov. 1937.

Distribution. The species has been recorded from the deep waters of the Atlantic.

Genus *Gaidius* GIESBRECHT, 1895

Up to the present time, none of the species belonging to the genus has been recorded from Japanese waters. I have found in the collection the following species: *Gaidius tenuispinus* SARS, *G. minutus* SARS, *G. brevispinus* SARS and *G. moderatus* n.sp. The genus is characterized by one-pointed rostrum, short endopodite of second antenna, and two jointed endopodite of first leg. Male resembles female in general appearance, and is characterized by the reduction of thoracic spine; mouth parts and outer edge spine of second joint of exopodite of first leg are also reduced. Fifth pair of legs have each a rudimentary endopodite on second basal joint.

Gaidius tenuispinus G. O. SARS, 1900

(Fig. 37, *a–k*)

Chiridius tenuispinus SARS, 1903, p. 30; *Gaidius similis* A. SCOTT, 1909, p. 51, pl. 7; *Gaidius tenuispinus* ESTERLY, 1911, p. 316; WITH, 1915, p. 89; SARS, 1925, p. 46; FARRAN, 1926, p. 249; FARRAN, 1929, p. 231; SEWELL, 1929, p. 100; JESPERSEN, 1934, p. 58; BRODSKY, 1950, p. 164; VERVOORT, 1950, p. 15; VERVOORT, 1951, p. 81.

Female. Length, 3.44 mm: cephalothorax, 2.75 mm; abdomen, 0.69 mm. The specimen agrees quite well with the description and figures given by SARS. Lateral spines of last thoracic segment slender and long (fig. *a*, *b*, *c*).

Abdomen 4–segmented, segments and furca in the proportional lengths 41 : 18 : 13 : 10 : 18 = 100; furcal rami about 1.3–times as long as wide.

First antenna 24–jointed, extends about to distal margin of 2nd abdominal segment; joints with proportional lengths:

Joint	1	2	3	4	5	6	7	8–9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
	29	50	23	26	26	29	29	44	23	23	23	41	41	44	48	50	53	70	54	53	70	67	56	20 = 1000.

Mouth parts and swimming legs as figured by SARS. Number of teeth on terminal spine of exopodite of second to fourth legs are 23, 20 and 26 respectively. First basal joint of maxillipede (fig. *d*) and first leg (fig. *e*) as shown in the figure.

Male. Length, 2.07 mm: cephalothorax, 1.67 mm; abdomen, 0.60 mm. The general appearance as SARS' figure (fig. *f*, *g*, *i*). Rostrum somewhat differs from the figures given by WITH; it is not so sharply produced (fig. *h*). Abdomen 5–segmented, segments and furca with proportional lengths 19 : 30 : 19 : 19 : 2 : 11 = 100; furcal rami about as long as wide.

First antenna 21–jointed, extends to distal margin of second abdominal segment; joints are in proportional length:

Joint	1	2	3	4	5	6	7	8–9–10	11	12–13	14	15	16	17	18	19	20–21	22	23	24	25
	27	27	16	21	26	26	32	69	27	63	37	48	53	58	63	74	128	79	74	43	11=1000.

Second antenna with exopodite about as long as endopodite; first basal joint has rows of hairs on posterior surface; and a strong inner marginal seta. Mandible with a robust second basal joint. Outer lobe of maxilla has 7 setae, exopodite has 11 setae, endopodite has 9 setae. Second maxilla reduced and thin-skined. Maxillipede has slender basal joints.

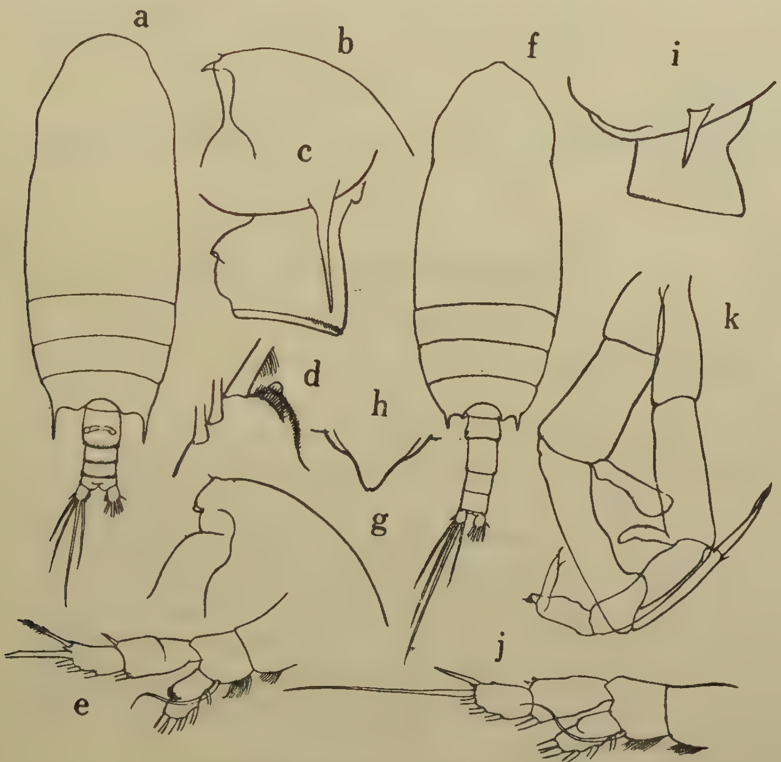

Fig. 37. *Gaidius tenuispinus* (G. O. Sars).
a, Female: dorsal aspect; *b*, head, lateral aspect; *c*, last thoracic segment and genital segment, lateral aspect; *d*, distal margin of 1st basal joint of maxillipede; *e*, 1st leg; *f*, Male: dorsal aspect; *g*, head, lateral aspect; *h*, rostrum, anterior aspect; *i*, last thoracic segment, lateral aspect; *j*, 1st leg; *k*, 5th pair of legs.

In first leg first and second joints of exopodite are fused; outer edge spine of second joint of exopodite is very minute; third joint of exopodite has a slight prominence furnished with fine spinules on the distal one-third of the outer margin (fig. *j*). Second leg has 1-jointed endopodite; in exopodite outer edge spine of second joint reaches the base of proximal spine of third joint; distal outer edge spine of third joint is about half as long as third joint of exopodite; terminal spine has 24 teeth. Third and fourth legs have each 3-jointed endopodite; number of teeth on terminal spine of exopodite are 17, and 14 respectively. Fifth pair of legs as figured by SARS (fig. *k*).

Remarks. Male specimen resembles *Gaidius similis* A. SCOTT, but differs from it in the followings: shape of rostrum, minute outer edge spine of second joint of exopodite of first leg, one-jointed endopodite of second leg, and small size.

Occurrence. Two adult and three immature females and one adult male from Sagami, in vertical hauls from 1000–0 m.

Distribution. The species appears to be widely distributed in the Pacific, Atlantic and Indian Oceans.

Gaidius brevispinus G. O. SARS

(Fig. 38, *a–k*)

Gaidius brevispinus SARS, 1903, p. 162; WITH, 1915, p. 94; SARS, 1925, p. 48; BRODSKY, 1950, p. 158.

Female. Length, 4.40 mm: cephalothorax, 3.45 mm; abdomen, 0.95 mm; so abdomen is contained 3.6-times in length of cephalothorax. Cephalothorax moderately robust (fig. *a*, *b*). Lateral corners of last thoracic segment broadly rounded, with short oblique spine (fig. *c*). Rostrum one-pointed, slightly notched at the apex.

Abdomen 4-segmented, segments and furca with proportional length 40 : 15 : 9 : 17 : 19 = 100. Genital segment robust. Furcal rami 1.4-times as long as wide.

First antenna 24-jointed, reaches back to distal end of third abdominal segment. Mouth parts as those of other member of the genus; second maxilla has a lamellous process on the posterior margin about the middle of first basal joint. Maxillipede as shown in the figure (fig. *d*).

First leg has 3-jointed exopodite and 1-jointed endopodite; outer edge spine of second joint of exopodite is long and slender. Second leg has 3-jointed exopodite and 2-jointed endopodite; terminal spine of exopodite has 21 teeth (fig. *e*). Terminal spine of exopodite of third and fourth legs have each 21 and 27 teeth respectively. In fourth leg first basal joint has a row of bristles on the base of the inner marginal seta. Proportional lengths of terminal spine of exopodite to third joint of exopodite are as follows: second leg, 26 : 21, third leg, 28 : 25, fourth leg, 28 : 26.

Male. Length 2.94 mm: cephalothorax, 2.26 mm; abdomen, 0.68 mm. Cephalothorax robust; the greatest width 1.02 mm; lateral spines of last thoracic segment small (fig. *g*). Frontal organ prominent (fig. *f*). Rostrum notched at the apex (fig. *h*).

Abdomen 5-segmented, segments and furca with proportional lengths 23 : 26 : 18 : 15 : 3 : 15 = 100. Furcal rami 1.2-times as long as wide. Second to fourth segments are fringed with fine teeth on the distal margin.

First antenna 21-jointed, extends to distal margin of second abdominal segment; joints are in the proportional lengths:

Joint	1	2	3	4	5	6	7	8-9-10	11	12	13	14	15	16	17
	26	29	22	22	26	26	29	66	29	33	29	29	54	56	56

	18	19	20–21	22	23	24–25
	59	74	118	77	70	70=1000;

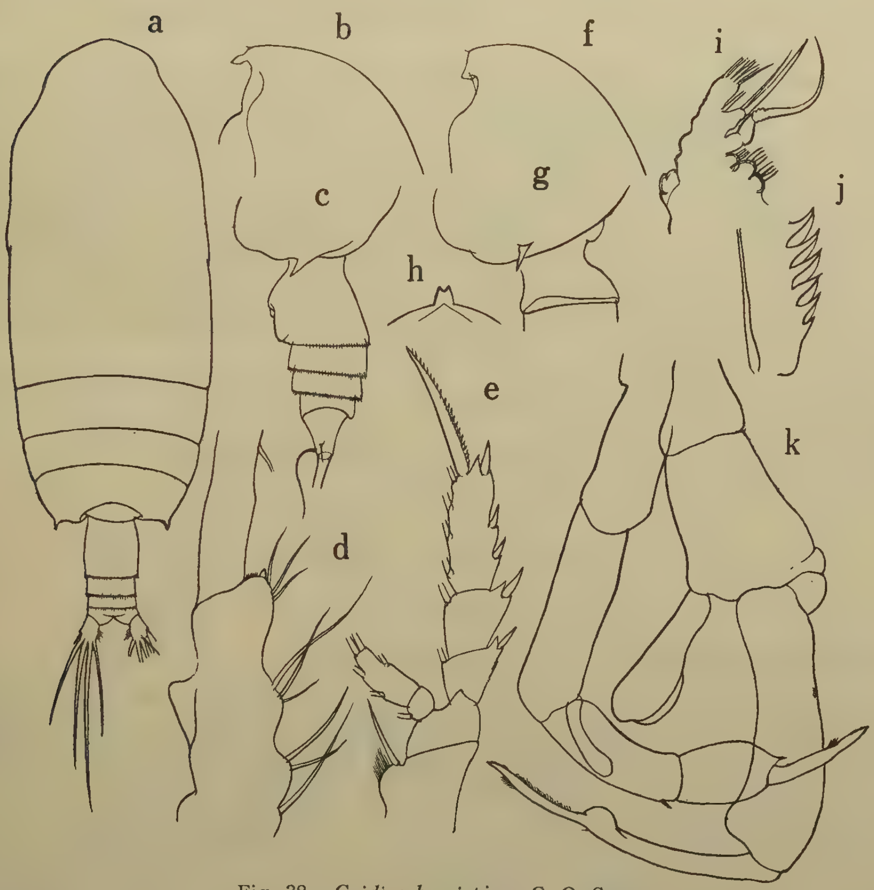

Fig. 38. *Gaidius brevispinus* G. O. Sars.

a, Female: dorsal aspect; *b*, head, lateral aspect; *c*, last thoracic segment and abdomen, lateral aspect; *d*, 1st basal joint of maxillipede; *e*, 2nd leg; *f*, Male: head, lateral aspect; *g*, last thoracic segment, lateral aspect; *h*, rostrum, anterior aspect; *i*, 2nd maxilla; *j*, terminal spine of exopodite of 4th leg; *k*, 5th pair of legs.

joints 24–25 are longer in proportion than those of *G. tenuispinus.* Second antenna, and mandible as in *G. tenuispinus.* First maxilla with 7+2 setae on outer lobe. Second maxilla reduced; fourth lobe has a remarkable seta (fig. *i*). Maxillipede slender.

First leg with 3-jointed exopodite second joint of exopodite with a minute outer edge spine; no protuberance on outer margin of third joint. Second leg with 2-jointed endopodite; terminal spine of exopodite has 27 teeth which is connected with lamellous thin plate. Third and fourth legs with 3-jointed endopodite; number of teeth on terminal spine of exopodite are 23 and 29 respectively (fig. *j*); first basal joint of fourth leg is smooth on the inner margin. Fifth pair of legs as those of the preceding species, and agree fairly well with Sars' figures of ***tenuispinus*** except that the endopodite of the left leg is shorter; second joint of exopodite of left leg is robust, and carries a single small spine on the inner distal margin (fig. ***k***).

Remarks. The female specimens of *Gaidius brevispinus* (4.8 mm), *G. intermedius* Wolfenden (=*Mesogaidius intermedius*) (4.0–4.15 mm) and *G. affinis* Sars (3.60 mm) resemble each other in having a short spine on lateral corner of last thoracic segment; these three species have also a lamellous process on first basal joint of the maxillipede; their first antennae are of about equal proportional lengths. Comparing the present specimen with these three species, lamellous process of maxillipede comes nearest to that of *G. brevispinus*; outer edge spine of second joint of exopodite of first leg is longer than that of *G. intermedius.* It seems to be most reasonable to regard the present specimen as *G. brevispinus.*

Occurrence. Four adult females and one male from Sagami, in vertical hauls 1000–0 m.

Distribution. The species has been recorded from the Atlantic.

Gaidius minutus G. O. Sars

(Fig. 39, *a–f*)

Gaidius minutus Sars, 1925, p. 49; Sewell, 1929, p. 100.

Female. Length, 2.62 mm: cephalothorax, 2.12 mm; abdomen, 0.50 mm. Cephalothorax robust. Head fused with first thoracic segment; the fourth and fifth are fused (fig. *a*, *b*, *c*). Last thoracic segment produced into a small nodule on each side. Rostrum short, one-pointed, slightly notched at the apex (fig *d*).

Abdomen 4-segmented, segments and furca with proportional lengths 42 : 13 : 11 : 11 : 23 = 100. Genital segment produced below. First three segments are fringed with fine teeth on the distal margin. Furcal rami 1.5-times as long as wide.

First antenna 24-jointed, reaches back to distal end of abdomen; joints are in the following proportional lengths:

Joint	1	2	3	4	5	6	7	8–9	10	11	12	13	14	15	16	17
	34	37	24	24	27	30	30	44	24	27	27	44	44	47	50	50

18	19	20	21	22	23	24	25
54	67	61	50	67	61	54	24 = 1000.

Second antenna with exopodite a little longer than endopodite. First maxilla with 9 setae on outer lobe, 11 setae on exopodite, 14 setae on endopodite, 5 setae on second basal joint, 4 setae on third inner lobe, 14 setae on first inner lobe. In maxillipede distal inner lobe of first basal joint has, beside usual 3 setae, a small lamellous process.

In first leg first and second joints of exopodite fused; outer edge spine of third joint is longer than the joint itself (fig. *e*). Second to fourth legs are of *Aetideus*-type; terminal spine of exopodite of second leg has 19 teeth (fig. *f*). Fourth leg has stiff hairs on inner margin near base of inner marginal spine of first basal joint.

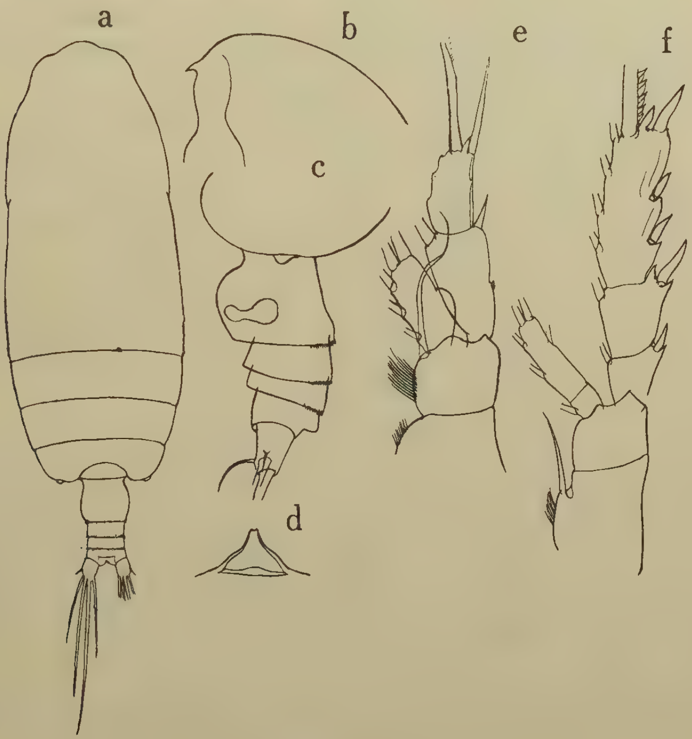

Fig. 39. *Gaidius minutus* G. O. SARS.

a, Female: dorsal aspect; *b*, head, lateral aspect; *c*, last thoracic segment and abdomen, lateral aspect; *d*, rostrum, anterior aspect; *e*, 1st leg; *f*, 2nd leg.

Remarks. The present specimen, though slightly differs from SARS' description in having small nodules on lateral corner of last thoracic segment, agrees quite well in other respects with *G. minutus*.

Occurrence. Each an adult female both from Sagami and Suruga, from the deep layers.

Distribution. The species has been recorded from the Atlantic and Indian Oceans.

Gaidius moderatus sp. nov.

(Fig. 40, *a–p*)

Female. Length, 3.53 mm: cephalothorax, 2.78 mm; abdomen, 0.75 mm; so abdomen is contained 3.7-times in the length of cephalothorax. Cephalothorax moderately robust, and oval in dorsal view; the greatest width little shorter than half the length of cephalothorax; head fused with first thoracic segment; last two thoracic segments are fused (fig. *a*, *b*). Lateral spines of last thoracic segment rather slender, and somewhat convergent; the spine does not reach the middle of genital segment (fig. *c*). Rostrum triangular and slightly notched at the apex (fig. *f*).

Abdomen 4–segmented, segments and furca with proportional lengths 39 : 17 : 15 : 12 : 17 = 100. Genital segment produced below. First three segments are furnished with fine teeth on the distal margin. Furcal rami little longer than wide (7 : 6).

First antenna 24–jointed, reaches back to distal margin of genital segment when fully extended; joints are in the following proportional lengths:

Joint	1	2	3	4	5	6	7	8–9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
	32	45	22	22	26	30	30	48	25	25	25	42	45	48	51	51	51	67	61	48	67	64	54	22=1000;

second to eighth joints have several fine hairs on posterior margin. Second antenna has exopodite 1.2–times as long as endopodite; exopodite robust; inner marginal setae of second joint of endopodite is based each on a small knob; endopodite slender. Mandible as in other members of the genus. First maxilla as shown in the figure; outer lobe has 9 setae; exopodite 11 setae; endopodite 14 setae (fig. *g*). Second maxilla as that of *G. minutus*. Maxillipede has a small lamellous process on fourth lobe of first basal joint (fig. *h*).

First leg with 2-jointed exopodite; line of fusion between the first and second joints faintly visible on anterior surface (fig. *i*). Second leg with 2–jointed endopodite; terminal spine of exopodite has 19 teeth which are connected with a sort of lamina. Third leg with 3–jointed endopodite; terminal spine of exopodite has 17 teeth. Fourth leg has a row of stiff hairs on inner margin of first basal joint; terminal spine of exopodite has 20 teeth (fig. *k*).

Male. Length, 3.19 mm: cephalothorax, 2.46 mm; abdomen, 0.3 mm; the greatest width of cephalothorax, 1.00 mm. Lateral spines of last thoracic segment, though broken off in the distal part, appears to be fairly long, and reaches the middle of first abdominal segment; it is convergent and moderately wide at the base (fig. *l*, *o*). Rostrum acutely pointed when viewed from the lateral; the apex slightly notched (fig. *m, n*)

Abdomen 5–segmented, segments and furca with proportional lengths 19 : 29 : 19 : 17 : 2 : 14 = 100. Furcal rami about 1.3–times as long as wide; furcal setae more than 2–times as long as abdomen and furca taken together.

First antenna 20-jointed, extends to distal margin of furca; joints are in the following proportional lengths;

Joint	1	2	3	4	5	6	7	8-9-10	11	12-13	14	15	16	17	18	19	20-21	22	23	24-25
	33	36	23	23	26	30	30	69	27	60	33	48	51	54	58	69	114	75	72	69=1000.

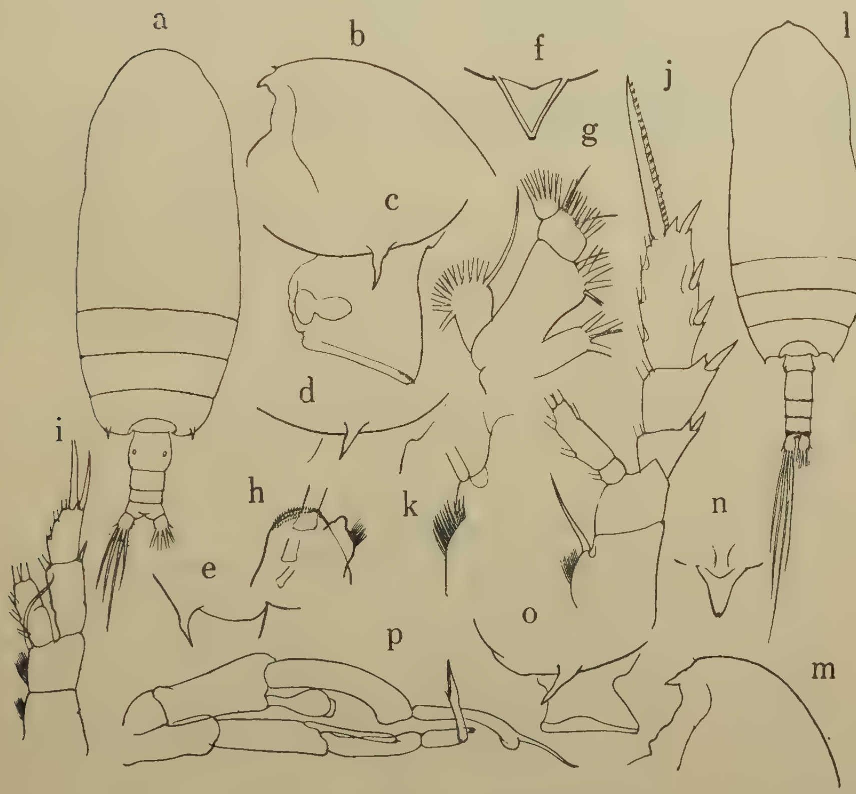

Fig. 40. *Gaidius moderatus* sp. nov.

a, Female: dorsal aspect; *b*, head, lateral aspect; *c*, last thoracic segment and genital segment, lateral aspect; *d*, last thoracic segment, lateral aspect, other specimen; *e*, lateral spine of last thoracic segment, dorsal aspect; *f*, rostrum, anterior aspect; *g*, 1st maxilla; *h*, distal margin of 1st basal joint of maxillipede; *i*. 1st leg; *j*, 2nd leg; *k*, inner margin of 1st basal joint of 4th leg; *l*, Male: dorsal aspect; *m*, head, lateral aspect; *n*, rostrum, anterior aspect; *o*, last thoracic segment, lateral aspect; *p*, 5th pair of legs.

Second antenna as those of the foregoing species; first joint of exopodite is furnished with long hairs on the inner margin. Mandible with a wide second basal joint. First maxilla much reduced, and has 7 long setae on first outer lobe, 11 setae on exopodite, 10 setae on endopodite. Second maxilla and maxillipede as those of the male of foregoing species.

First leg with 2-jointed exopodite; line of fusion between first and second joint faintly visible on the anterior surface. Second leg with 2-jointed endopodite; exopodite broken off. In fourth leg first basal joint is smooth on the inner margin. Fifth pair of legs as those of the foregoing species (fig. *p*).

Remarks. Female specimen resembles *Gaidius pungens* GIESBRECHT, except for the following minute points of difference: posteri~~i~~or spines of last thoracic segment are shorter in proportion than figured by GIESBRECHT; endopodite of second leg 1-jointed in GIESBRECHT's specimen, but the present specimen has 2-jointed endopodite. Posterior spines of last thoracic segment show some variations as shown in the figure.

Occurrence. One female and one male from Sagami, in vertical hauls from 1000–0 m.

(To be continued)

THE SPECIES OF THE GENUS *ELYSIA* FROM JAPAN[1]

KIKUTARÔ BABA

Biological Laboratory, Osaka Gakugei University

With Plates III–IV and 1 Text-figure

The following is a revised list of the species of the genus *Elysia* so far known from the waters around us (see also BABA 1949 and 1955). Two forms from Ryûkyû are also included in the list.

1. *Elysia* (*Elysia*) *japonica* ELIOT, 1913
   Loc.: Unknown.
2. *Elysia* (*Elysia*) *yaeyamana* BABA, 1936 Yaeyama-midorigai (n.n.)
   Loc.: Ishigakishima, Ryûkyû.
3. *Elysia* (*Elysia*) *obtusa* BABA, 1938 Otome-midorigai
   Loc.: Sagami Bay; Kii; Tsuruga Bay; Toyama Bay.
4. *Elysia* (*Elysia*) *babai* PRUVOT-FOL, 1946 = *Elysia viridis* BABA, 1936 Ishigaki-midorigai (n.n.)
   Loc.: Ishigakishima, Ryûkyû.
5. *Elysia* (*Elysia*) *trisinuata* BABA, 1949 Hiramiru-midorigai
   Loc.: Sagami Bay; Sugashima near Toba; Kii; Toyama Bay.
6. *Elysia* (*Elysia*) *splendens* BABA, 1949 Hana-midorigai
   Loc.: Sagami Bay.
7. *Elysia* (*Elysia*) *hirasei* BABA, 1955 Gokuraku-midorigai
   Loc.: Sagami Bay.
8. *Elysia* (*Elysia*) *abei* BABA, 1955 Abe-midorigai
   Loc.: Sagami Bay; Osaka Bay; Tsuruga Bay; Toyama Bay; Sado Island.
9. *Elysia* (*Elysia*) *amakusana* BABA, 1955 Azuki-umiushi
   Loc.: Sagami Bay; Amakusa; Toyama Bay.
10. *Elysia* (*Elysia*) *atroviridis* BABA, 1955 Kuro-midorigai
    Loc.: Sagami Bay; Suruga Bay; Sugashima near Toba; Kii; Tsuruga Bay; Toyama Bay; Sado Island.
11. *Elysia* (*Elysia*) *livida* BABA, 1955 Chigo-midorigai
    Loc.: Sagami Bay; Toyama Bay.

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[1] Contributions from the Seto Marine Biological Laboratory, No. 293.

Publ. Seto Mar. Biol. Lab., VI (1), 1957. (Article 4)

12. *Elysia* (*Elysia*) *sugashimae* BABA, 1955 Sugashima-midorigai
    Loc.: Sagami Bay; Sugashima near Toba; Tsuruga Bay; Sado Island.
13. *Elysia* (*Elysia*) *grandifolia* KELAART, var. *orientalis* BABA, n.n. = *Elysia grandifolia* BABA, 1937 Konoha-midorigai
    Loc.: Amakusa; Toyama Bay.

The following are here added to the list above.

14. *Elysia* (*Elysia*) *halimedae* MACNAE, 1954 Uchiwa-midorigai
15. *Elysia* (*Elysia*) *hamatanii* BABA, n. sp. Hamatani-midorigai (n.n.)
16. *Elysia* (*Elysia*) *kushimotoensis* BABA, n. sp. Kushimoto-midorigai (n.n.)
17. *Elysia* (*Elysia*) *tokarensis* BABA, n. sp. Tokara-midorigai (n.n.)
18. *Elysia* (*Elysia*) *nigrocapitata* BABA, n. n. Izumi-midorigai (n.n.)
19. *Elysia* (*Elysia*) *marginata* (PEASE), var. *minor* BABA, n. var. Hime-konoha-midorigai (n.n.)

Elysia (*Elysia*) *halimedae* MACNAE

(Pl. III, Fig. 1; Pl. IV, Figs. 1a–1b)

Elysia halimedae MACNAE 1954, pp. 57–59, pl. 3, fig. 2, text-fig. 2.—S. Afr.

Animal at rest closely associated with *Halimeda cuneata* on which it is attached, in general shape and in colouring. Total length about 20 mm. Parapodia much expanded, somewhat like a leaf of *Halimeda*, and the surface apparently smooth to the naked eyes. Rhinophores minutely papillated. The whole animal is grass-green, and it is everywhere covered with white spots which are thickest towards the outer surface of the parapodia. Upper half of the rhinophores light yellowish brown. Radula with 9 teeth in the ascending series, and 12 teeth in the descending series; each of the teeth distinctly denticulated on both edges. Spawning in early August (see BABA 1956, p. 218).

Loc.: Wagu, Shima Province (Aug. 1951, 1 sp., coll. by the author).

Elysia (*Elysia*) *hamatanii* BABA, n. sp.

(Pl. III, Fig. 2; Pl. IV, Figs. 2a–2b)

Length 5–13 mm. The black bands on the head are more accentuated than in *E. hirasei* BABA (see BABA 1949, pp. 34–35, 131, pl. 8, fig. 25, text-fig. 24; BABA 1955, pp. 11, 41–42): there are 3 of these running from between the rhinophores to the anterior end of the pericardium, and an additional one immediately below the eyes on both sides. The paired rhinophores are combined by a black band across the fore end of the head. General body-colour yellowish green or grass-green, the outer surface of parapodia somewhat darker and with white spots all over, Radula type approximately as in *hirasei* : the ascending series with 10 teeth, the descending series with 13 teeth, all of these finely denticulated. This species is regarded as new to science.

Loc. : Seto, Kii (Jan. 1951, 2 sps., coll. by Mr. HAMATANI ; Dec. 1955, many sps., coll. by the author).

Elysia (*Elysia*) *kushimotoensis* BABA, n. sp.

(Pl. III, Fig. 3 ; Pl. IV, Figs. 3a–3b)

Length about 30 mm. Ground-colour yellowish green, the head brownish, the parapodial surface more darker, almost chocolate brown, and conspicuously maculated with white ; the whole body scattered with additional orange-red spots. Parapodial margin with a double border, the outer black and the inner orange-red. Rhinophores brownish to the tip. Radula with 7 teeth in the ascending series, 7 teeth in the descending series, and a heap of these in the ascus. All the teeth finely denticulated.

Loc. : Kushimoto, Kii (Aug. 1951, 1 sp., coll. by Mr. HAMATANI).

Elysia (*Elysia*) *tokarensis* BABA, n. sp.

(Fig. 1 ; Pl. IV, Figs. 4a–4b)

Somewhat allied to *E. yaeyamana* in general colouring, but distinct from it in having black spots on parapodia, and in the shape of the radula teeth. Length of animal about 15 mm. Ground-colour yellowish green (or bluish green), the parapodial margin ashy white or almost purplish black, and with a submarginal chrome-yellow line. White spots as usual scattered on parapodial surface. Rhinophores faintly black at extreme tip, and with a chrome-yellow band about halfway down. Radula with 5 teeth in the ascending series, 7 teeth in the descending series, and a heap of these in the ascus. Each tooth finely denticulated at edge.

Loc. : Takarajima of Tokara group, southern Kyûshû (May 1953, 3 sps., coll. by the author).

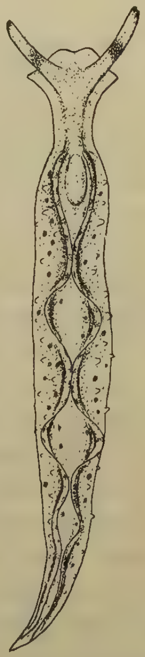


Fig. 1. *Elysia tokarensis* (Takarajima, May 26, 1953, total length 15 mm).

Elysia (*Elysia*) *nigrocapitata* BABA n. n.

(Pl. III, Fig. 4 ; Pl. IV, Figs. 5a–5b)

Elysia (*Elysia*) *viridis* BABA 1947, p. 1077, fig. 3050 (non text).

About 5 mm in length. Head black excepting round the eyes. General body-colour yellowish green, becoming darker towards the outer surface of the parapodia, and to the tip of the tail. The parapodial margin white. Radula with 10 teeth in the ascending series, 12 teeth in the descending series, and a heap of these in the ascus. All the teeth very finely denticulated. The black head especially characterizes the species.

Loc.: Tannowa, Osaka Bay (Nov. 1950 and Dec. 1952, several sps., coll. by Mr. HAMATANI); Seto, Kii (Dec. 1955, 1 sp., coll. by the author); Myojinzaki Mizushima, Tsuruga Bay (July 1956, 1 sp., coll. by Mr. ABE); Abugashima, Toyama Bay (Aug. 1953, 1 sp., coll. by Mr. ABE); Amaharashi, Toyama Bay (Dec. 1955 and Aug. 1956, many sps., coll. by Mr. ABE).

Elysia (*Elysia*) *marginata* (PEASE), var. *minor* BABA, n. var.

(Pl. III, Fig. 5; Pl. IV, Figs. 6a–6b)

The two species, *E. grandifolia* KELAART and *E. marginata* (PEASE), are much alike in general body-form and in colouring. But it is generally noted that the radula teeth of the former are denticulated and those of the latter non-denticulated. Our specimens which will be described below have obviously the radula type of the latter species. They appear, however, to be distinguished from the typical *marginata* by the smaller size of body and by the narrower parapodia having 3 natural undulations on the edge.

Length usually 12–17 mm, at most 40 mm. General ground-colour yellowish green, the whole outer surface of body including the sole rather thickly spotted with black. With additional white spots all over as usual. Parapodia with a double border, the outer black and the inner orange-red. The rhinophores orange-red towards the tip, their auriculate margin black. The tip of the tail not black. Radula usually with 5 teeth in the ascending series, 7–10 teeth in the descending series, and a heap of these in the ascus. No denticulations found on edge of teeth. All of our specimens are tentatively regarded as forming a new variety of the typical *marginata*.

Loc.: Seto, Kii (Aug. 1952, 2 sps., coll. by Messrs. YAMAMOTO, HAMATANI and HISAI); off Sajima, Sagami Bay, 11 m (Aug. 1940, 1 sp., coll. by His Majesty's Biol. Lab.); Myojinzaki Mizushima, Tsuruga Bay (July 1956, 1 sp., coll. by Mr. ABE); Abugashima, Toyama Bay (July 1953, 2 sps., coll. by Mr. ABE).

Additional notes

1. *Elysia* (*Elysia*) *grandifolia* KELAART, var. *orientalis* BABA, n. n. This agrees with the typical *grandifolia* from the Indian Ocean (1) in colours, (2) in the exceedingly wide parapodia and (3) in the serrulated radula teeth, but appears to differ from it (1) in the shorter radula ribbon and (2) in the acutely pointed blade of each of the teeth (cf. O'DONOGHUE 1932).

2. *Elysia* (*Elysia*) *sugashimae* BABA (Pl. III, Fig. 6; Pl. IV, Figs. 7a–7b). The animal taken from Sugashima near Toba measures about 25 mm in length. General ground-colour grass-green, the whole upper surface of body covered with scattered orange-red spots, interspersed with white ones. Tip of rhinophores black. Radula with 7 teeth in the ascending series and 10 teeth in the descending series. Teeth unciform (see also BABA 1955).

LITERATURE

BABA, K. 1936. Opisthobranchia of the Ryûkyû (Okinawa) Islands. Journn. Dept. Agric. Kyûshû Imp. Univ., vol. 5, no. 1.

——— 1937. Opisthobranchia of Japan (I). Journ. Dept. Agric. Kyûshû Imp. Univ., vol. 5, no. 4.

——— 1938. Opisthobranchia of Kii, Middle Japan. Journ. Dept. Agric. Kyûshû Imp. Univ., vol. 6, no. 1.

——— 1947. Dôbutsu Zukan (Illustrated encyclopedia of the fauna of Japan), revised edition. Mollusca.

——— 1949. Opisthobranchia of Sagami Bay. Iwanami Shoten, Tôkyô.

——— 1955. Opisthobranchia of Sagami Bay. Supplement. Iwanami Shoten, Tôkyô.

BABA, K., Iw. HAMATANI and K. HISAI 1956. Observations on the spawning habits of some of the Japanese Opisthobranchia (II). Publ. Seto Mar. Biol. Lab., vol. 5, no. 2.

ELIOT, C. 1913. Japanese nudibranchs. Journ. Coll. Sci. Imp. Univ. Tôkyô, vol. 35, art. 1.

MACNAE, W. 1954. On four sacoglossan molluscs new to South Africa. Ann. Natal Mus., vol. 13, pt. 1.

O'DONOGHUE, C. H. 1932. Notes on Nudibranchiata from Southern India. Proc. Malac. Soc. London, vol. 20, pt. 3.

PRUVOT-FOL, A. 1946. Révision critique de la famille des Elysiadae. Journ. de Conchyliol., vol. 87, no. 1.

——— 1947. Post scriptum a la révision critique de la famille des Elysiadae. Journ. de Conchyliol., vol. 87, no. 3.

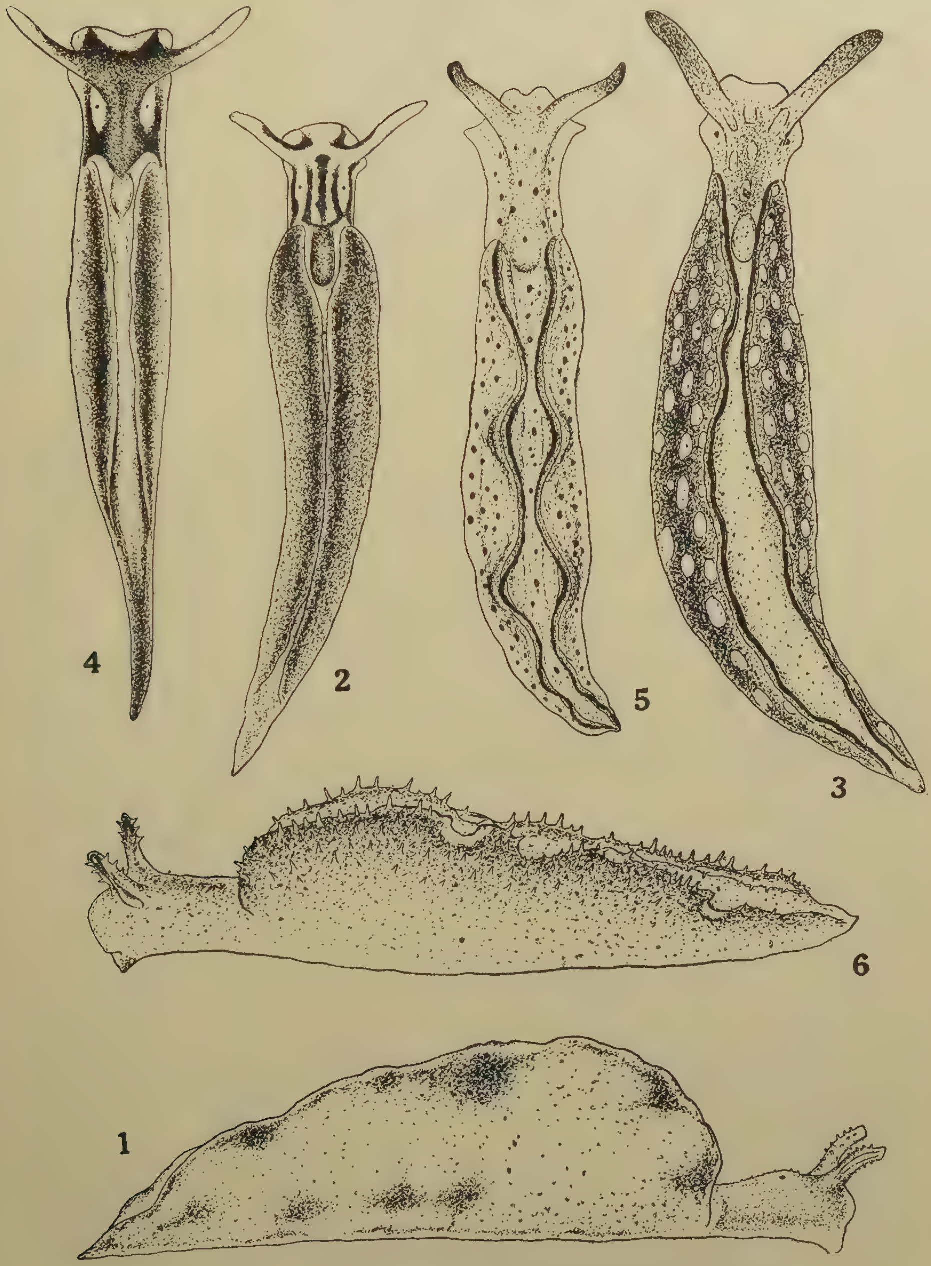
EXPLANATION OF PLATES III-IV

PLATE III

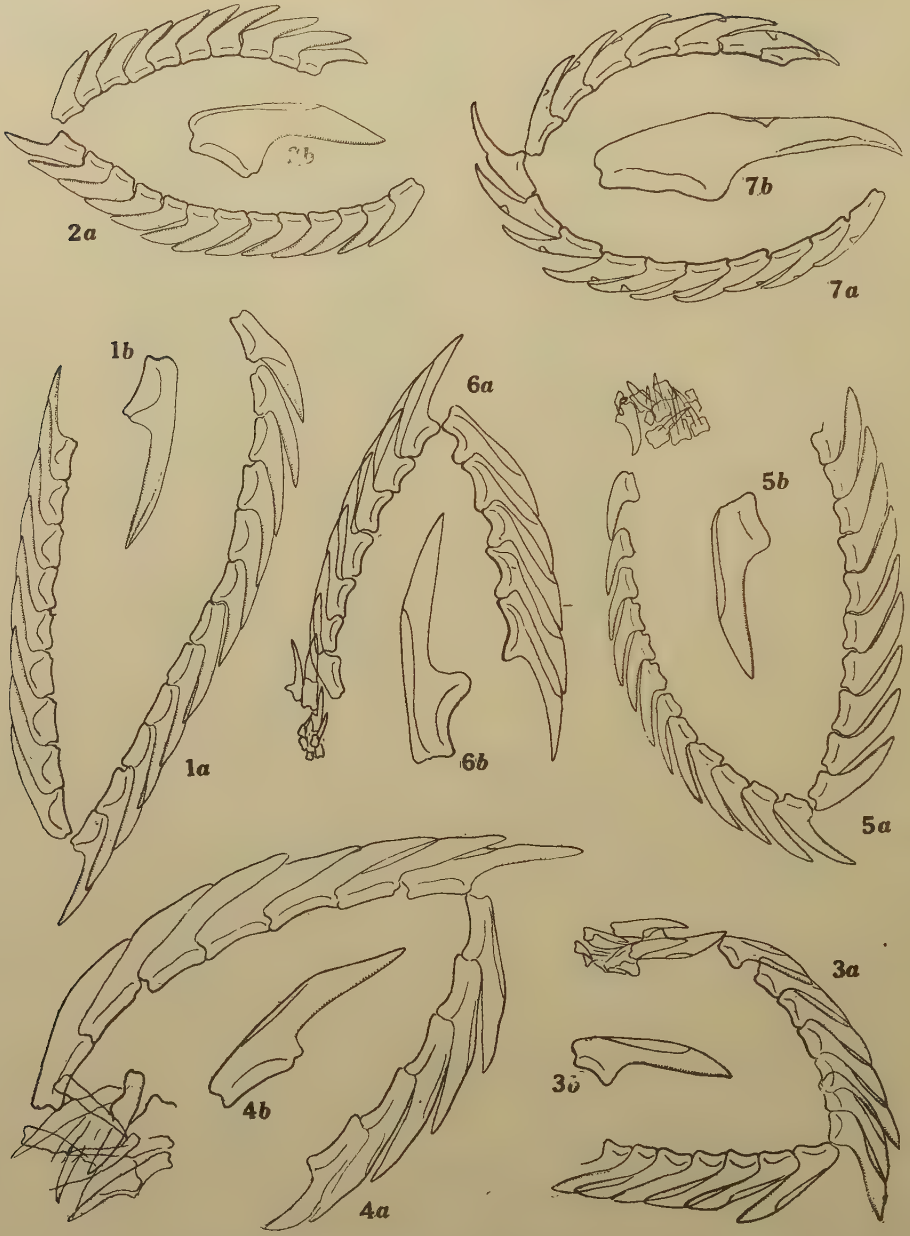
Fig. 1. *Elysia halimedae* (Wagu, Shima Province, Aug. 2, 1951, length 20 mm).
Fig. 2. *Elysia hamatanii* (Seto, Jan. 4, 1951, length 10 mm).
Fig. 3. *Elysia kushimotoensis* (Kushimoto, Kii, Aug. 7, 1951, length 30 mm).
Fig. 4. *Elysia nigrocapitata* (Tannowa, Osaka Bay, Nov. 23, 1950, length 5 mm).
Fig. 5. *Elysia marginata*, var. *minor* (Seto, Aug. 5, 1952, length 12 mm).
Fig. 6. *Elysia sugashimae* (Sugashima, July 8, 1952, length 25 mm).

PLATE IV

Figs. 1a–1b. *Elysia halimedae.*
  1a. Radula teeth (×100); 1b. A tooth (×160).
Figs. 2a–2b. *Elysia hamatanii.*
  2a. Radula teeth (×120); 2b. A tooth (×310).
Figs. 3a–3b. *Elysia kushimotoensis.*
  3a. Radula teeth (×120); 3b. A tooth (×160).
Figs. 4a–4b. *Elysia tokarensis.*
  4a. Radula teeth (×160); 4b. A tooth (×240).
Figs. 5a–5b. *Elysia nigrocapitata.*
  5a. Radula teeth (×310); 5b. A tooth (×620).
Figs. 6a–6b. *Elysia marginata*, var. *minor.*
  6a. Radula teeth (×220); 6b. A tooth (×310).
Figs. 7a–7b. *Elysia sugashimae.*
  7a. Radula teeth (×22); 7b. A tooth (×70).



K. BABA: THE SPECIES OF *ELYSIA* FROM JAPAN.


2a
2b
7b
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3a
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K. Baba: The Species of *Elysia* from Japan.

A NEW PORCELLANID CRAB FROM MIDDLE JAPAN[1][2]

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With 3 Text-figures

A new species of *Porcellana* described below was taken in the Tanabe Bay, Wakayama-ken, living commensally with spicular corals, *Dendronephthya gloriosa* and *D. castanea.*

I wish to express my hearty thanks to Dr. Huzio UTINOMI for his courtesy in handing the material over to me. I am also grateful to Prof. Dr. Yoshi Kuni HIRAIWA of the Kyushu University for his constant guidance.

Porcellana maculata sp. nov.

Diagnosis.—Carapace and legs smooth, glabrous; carapace slightly convex, not at all areolated; front as a rule four-lobed, of which median two lobes very broad. There is an acuminate tooth behind the post-ocular angle; lateral margin of carapace with an acute tooth. First peduncle of antennule with a few granulated ridges; inner angles of both anterior crests projecting upwards. Merus of third maxilliped with a round crest. Chelipeds unequal. Wrist with a laminate crest along the inner margin, the crest is entire in larger individuals, but serrated in smaller ones; fingers of the larger cheliped with an obtuse tooth on both inner margins, but those of the smaller one with minute teeth. Ambulatory legs of a moderate length; propodus with three or four spinules; dactylus with three spinules. Telson seven-lobed, the central one being very small. This species is commonly found on spicular corals, *Dendronephthya.* Carapace and cheliped marked with red spots.

Description of holotype—Male, cl.[3] 3.8 mm, cb.[4] 3.3mm. Carapace slightly longer than broad, a little convex, smooth, not all areolated. Front four-lobed, much produced forwards. There is an acuminate tooth behind the post-ocular angle. Lateral margin of carapace armed with an acute tooth.

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[1] Contributions from the Zoological Laboratory, Faculty of Agriculture, Kyushu University, No. 231.

[2] Contributions from the Seto Marine Biological Laboratory, No. 294.

[3, 4] The abbreviation cl. is used for "length of carapace", cb. for "breadth of carapace".

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First peduncle of antennule a little longer than broad, ventral surface smooth, upper surface furnished with a few granulated ridges running transversely, inner angles of both anterior crests projecting upwards. Peduncles of antenna smooth, cylindrical; second peduncle armed with an acuminate spinule on upper margin. The relative lengths of basal peduncles are II : III : IV = 1 : 1.3 : 1. Third maxilliped smooth; ventral surface of ischium ornamented with oblique ridges, the crest of merus much produced inwards.

Cheliped unequal, the right one being larger; surface smooth, glabrous like the carapace. Arm longer than broad, upper anterior margin undulated; its upper distal end of the right side acuminate, but that of the left obtuse; the lower margin prolonged at its distal end into rather acute spine. Wrist longer than broad, and provided with a laminate, entire crest on inner margin. The length of palm a little longer than twice the breadth, its lower surface slightly produced. Fingers of right side very short, and one-third the palm; immovable finger armed with an obtuse tooth at the middle of inner margin; movable finger also with an obtuse tooth at the base. Fingers of left (smaller) side rather slender, a little longer than half the length of palm, and furnished with minute teeth along the inner margin; there is no gap between fingers.

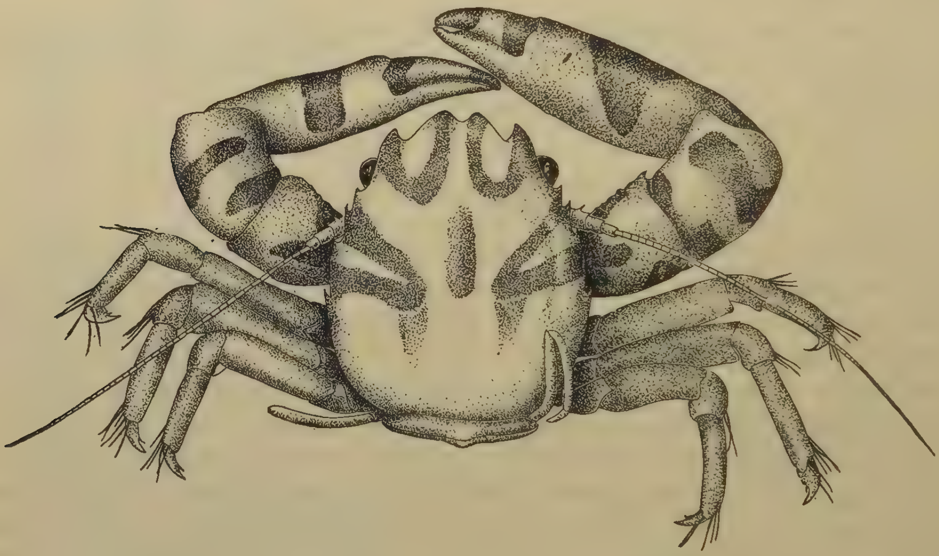

Fig. 1. *Porcellana maculata* sp. nov., male, holotype, ×8.

Ambulatory legs smooth, glabrous, of a moderate length. Merus unarmed, 3.5 times as broad as long. Carpus furnished with a few hairs on outer distal margin. Propodus 3.8 times as broad as long, and armed with four spinules, of which the two at distal end being in pair, another one just in frônt of them, and the remaining one at the middle of the segment; the last mentioned spinule is absent from the first and third pairs.

Telson seven-lobed, the central lobe being very small.

Paratypes.—Two males, cl. 2.6, cb. 2; cl. 2.5, cb. 1.7 mm. These specimens are very similar to the holotype, differing in only a few characters.

Front four-lobed, of which median two lobes subdivided irregularly into many minute teeth on inner margins; wrist armed with three acuminate teeth on inner margin.

Colour in alcohol.—Light brown, marked with reddish colour-patterns as in the text-figure 1.

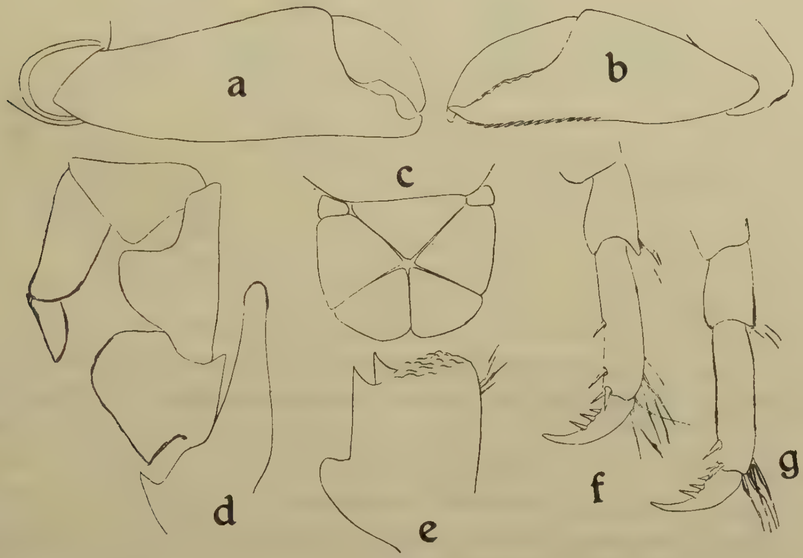

Fig. 2. *Porcellana maculata* sp. nov., holotype.

a, Outer view of right chela, ×12. *b*. outer view of left chela, ×12. *c*. telson, ×12. *d*, lower view of left third maxilliped, ×25. *e*, lower view of first peduncle of left antennule, ×40. *f*, second ambulatory leg, ×8. *g*, third ambulatory leg, ×8.

Relationships.—This species is closely allied to *Porcellana armata* DANA, but may be distinguished from it at first sight by the characters of the median lobes of carapace and chelipeds.

Disposition of types.—Holotype (S. M. B. L. Type 164), male is deposited in the Seto Marine Biological Laboratory, Shirahama, Wakayama-ken. Paratypes, two males, are deposited in the Zoological Laboratory, Faculty of Agriculture, Kyushu University, Fukuoka.

Type locality and habitat.—The specimens of holotype and paratypes were taken from the shore of Shisô-jima, Tanabe Bay, Wakayama-ken, on May 1, 1954, living commensally with *Dendronephthya gloriosa* UTINOMI, collected by a gill-net of spiny-lobster fishing.

Remarks.—According to Mr. Torao YAMAMOTO, this species is found at the shore of Susami, Wakayama-ken, in April, 1954, attached to *D. gloriosa.* And also found in Tanabe Bay, attached to *D. castanea* UTINOMI.

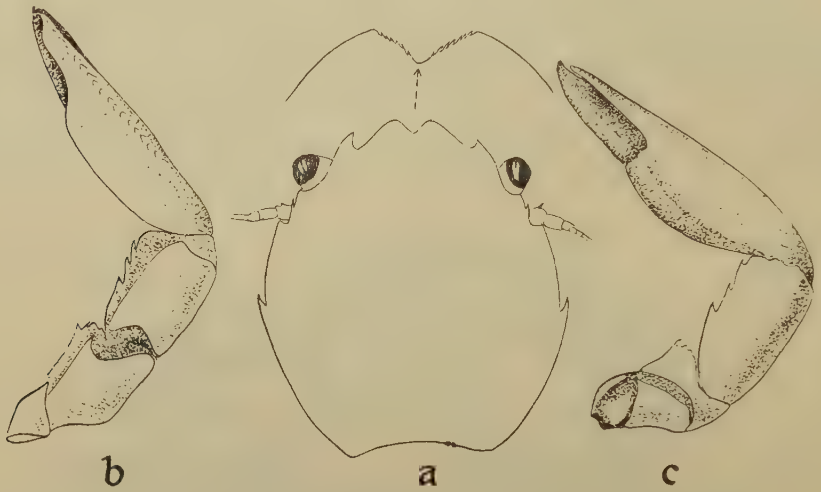

Fig. 3. *Porcellana maculata* sp. nov., male, paratype.
a, Dorsal view of carapace, ×10. *b*, ventral view of left cheliped, ×10. *c*, dorsal view of right cheliped, ×10.

LITERATURE CITED

DANA, J. D. 1852. Crustacea.—United States Exploring Expedition during the years 1838–1842, ..., Philadelphia, **13**: 1–1620; 1855, pls. 1–96.

MIYAKE, S. 1942. Studies on the Decapod Crustaceans of Micronesia. III. Porcellanidae. Palao Trop. Biol. Stat. Stud., Tokyo, **2** (3): 329–379, pl. 1, text-figs. 1–35.

———— 1943. Studies on the crab-shaped Anomura of Nippon and adjacent waters. J. Dep. Agric. Kyushu Imp. Univ., Fukuoka, **7** (3): 49–158, text-figs. 1–62.

DAILY RHYTHMIC ACTIVITY OF THE SEA-PEN, *CAVERNULARIA OBESA* VALENCIENNES

XV. CONTROLLING OF THE ACTIVITY BY LIGHT (3)[1][2]

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and

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With Plate V and 10 Text-figures

I. Introduction

The daily rhythmic activities, which are widely observable in the living world, have attracted interests of many investigators, and up to the present time a considerable number of researches have been published. Some important results among them were summarized by Park (1940), Calhoun (1944–1946), Mori (1948), Kleitman (1949) and Aschoff (1954, 1955).

From these works we know that daily rhythmic activities of many animals are controlled, on one hand by the change of environmental factors especially of light, and on the other hand by some intrinsic rhythmic factors (rhythmic changes of physiological states). But as to the interrelations of these external and internal factors, relatively few attentions have hitherto been paid.

The senior author has been studying the daily rhythmic activity of the sea-pen, *Cavernularia obesa*, since 1943, and has found that not only the change of light modifies the mode of its activity, but also some internal physiological rhythms lie beneath the normal exhibition of rhythmic activity. Namely, the sea-pen is performing its rhythmic pattern of life in nature under double assurances of mechanisms —rhythmic changes of internal physiological states and periodic changes of external solar illumination (Mori, 1943a, b; 1944a, b, c, d, e; 1945b; 1947a, b; 1948a; 1949; 1950: Takada and Mori, 1956; 1957).

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1) Contributions from the Seto Marine Biological Laboratory, No. 295.

2) This research was aided by the Scientific Research Expenditure of the Department of Education.

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Then, what would happen in its activity rhythm when phases of these two factors were made discordant with each other? To clarify these problems, the senior author has made a series of experiments which consisted of three sets of schemes: 1) reversing the environmental light-dark phase by using artificial light of various illumination intensities (viz. 1230 Lux, 130 Lux, 7 Lux, 1.2 Lux, 0.3 Lux; see Mori, 1944a, 1949), 2) changing the lengths of alternative light (ca. 1200 Lux) and dark period, keeping the lengths of both phases as equal (viz. 18 hours light—18 hours dark, 15–15, 9–9, 6–6; see Mori, 1944a, 1949), 3) changing the relative lengths of alternative light (ca. 1200 Lux) and dark phases, but keeping the total length of one cycle as constant—24 hours (vis. 18 hours light—6 hours dark, 15–9, 9–15, 6–18, 3–21; see Mori, 1944a, 1949). The results of these experiments were summarized in the report of 1950, with the conclusion that, although light influenced intensely the mode of rhythmic activity of the sea-pen by modifying its phases, the animal persisted more and more its original natural mode of activity as the intensities of artificial light became weaker or as the phase relations of alternative light and dark periods deviated further from the natural phase.

The present paper deals with the results of our further investigation concerning with the control of the activity by light, and with the synthetic discussion based on these and other experiments previously reported. The experiments mentioned in this report belong to the categories of the 2) and 3) schemes mentioned above.

The authors express here their sincere thanks to Prof. D. Miyadi who read the original manuscript and gave kind advices and to the members of the Seto Marine Biological Laboratory who afforded various facilities through the course of the study.

II. Materials and Methods

1. The sea-pens were collected from a shallow sandy bottom in the vicinity of the Seto Marine Biological Laboratory, few days or about a month prior to the experiments, and then reared in a large aquarium of the Laboratory until the experiments were started. Healthy colonies only were used for the experiments.

2. Before the experiments, the animals were transplanted one by one in the long glass cylinders placed in the laboratory as is shown in Plate V. The water was continuously circulated and kept overflowing. The animals could be maintained quite healthfully in these conditions, and showed normal rhythmic activity of daily contraction and nightly expansion. The length of the stem expanded above the sand was measured at certain intervals (usually at every 3 hours), which was taken as an index of the activity. The conditions of the individual polyps were not recorded in the present experiments.

3. The experiments to be reported here consist of three series. Firstly, the animals were subjected to the alternative light and dark conditions of equal lengths. As for this sort of experiment, the senior author had already described the features of activities under alternative 18 hours light and 18 hours dark cycle (designated

hereafter as 18–18 hours, light-dark cycle), 15–15 hours, 9–9 hours, and 6–6 hours, light-dark cycles. In this report we will add the results obtained under the 24–24 hours, 21–21 hours, 3–3 hours, 1.5–1.5 hours, 30–30 minutes, 15–15 minutes, and 5–5 minutes light-dark cycles.

Secondly, the alternative light and dark conditions of different duration, maintaining the total length of one cycle as 24 hours, were used as the light environment. As for this sort of experiments, the senior author had described the rhythmic features of activity under 18–6 hours, 15–9 hours, 9–15 hours, 6–18 hours, and 3–21 hours light-dark environmental cycles. In this report we will add the mode of activity under 21–3 hours light-dark condition.

Lastly, the animals were subjected to alternative 30–30 minutes light-dark condition for a relatively long period, ca. 10 days. This experiment was planned in order to scrutinize the relation existing between the environmental light conditions and the internal physiological states.

4 The intensity of light employed ranged between 1000–1700 Lux (mostly about 1200 Lux), being obtained from an electric lamp of 200–300 watts. Variations of light intensity in these degrees had practically no effect on such activities to be described here. Turning on or off of electric current was in most cases controlled by an automatic bell timer, and in other cases by the investigator himself. The water temperature was not controlled, but the experiments were always performed during the warmer season of a year, so that it was always maintained above 20°C. The senior author had previously ascertained that the feature of activity was manifested nearly similarly so long as the water temperature was maintained above 13°C (Mori, 1944b, c), so that the possible effect due to the variation in water temperature may be neglected.

III. Results

1. *The results of the first series of experiments*

a) Activities under alternative 21 hours illumination and 21 hours darkness (one cycle consists of 42 hours)

4 colonies were used. The experiment was performed during Sept. 20 to 26, 1954. The intensity of light used was about 1400 Lux, the water temperature varied between 24.3° to 27.7°C. Fig. 1 shows the results.

It may be seen that the activity of 2 colonies (Nos. 1 and 2) is disturbed or may be said as showing approximately 42 hours rhythm (dependent rhythm to the environment), 1 colony (No. 3) shows somewhat 9 to 12 hours rhythm (half of the normal rhythm) and the last 1 colony (No. 4) is affected at first, but ultimately shows natural 24 hours rhythm.

The appearance of the colony that seems to persist its normal rhythm is characteristic under the "adequately" shifted periodic light conditions. Although it was found by Mori (1949) that, under 18–18 hours light-dark condition, the activities

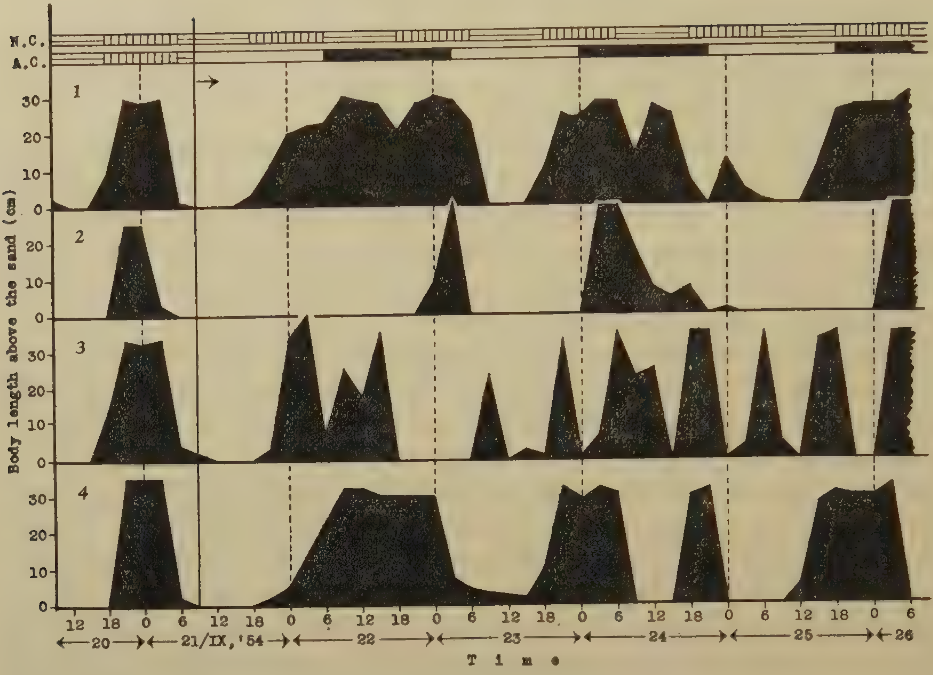


Fig. 1. Features of activity under 21-21 hours light-dark condition. Black areas show durations and degrees of expansion of animals above sand. N.C.: Natural day (▤) and night (▥) cycle. A.B.: Artificial light (□) and dark (■) cycle. Arrow in the figure indicates when the animals were subjected to the experimental light conditions.

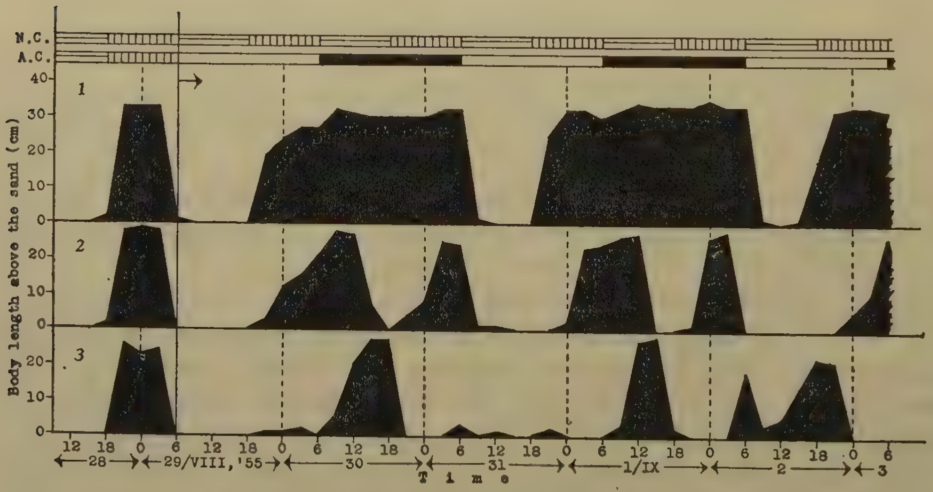


Fig. 2. Features of activity under 24-24 hours light-dark condition.

were not usually coincident with the environmental light periodicity (though 1 colony out of 4 showed to some extent a tendency to persist its original rhythm), under more abnormal conditions such as 21–21 hours light-dark cycle, the sea-pen that persisting clearly its original rhythmic activity appears.

b) Activities under alternative 24 hours illumination and 24 hours darkness (one cycle 48 hours)

Under a greater length of a cycle, what would happen in the mode of rhythmic activity? 3 colonies were used. The experiment was performed during Aug. 28 to Sept. 3, 1955. The intensity of light used was 1400 Lux, the water temperature varied between 26.7° to 28.1°C. The results are shown in Fig. 2.

The colony No. 1 shows modified 48 hours cycle. But because it begins to expand even when it is illuminated, its activity may be said as not truly dependent on the environmental light condition but as are controlled by the double forces—external and internal. No. 2 colony shows modified 24 hours cycle; it expands twice in the dark periods, but as it begins to expand even when it is illuminated as in the case of No. 1 colony, the persistency of the original rhythm seems to be fairly deep-rooted. The colony No. 3 is disturbed; no definite rhythmicity can be recognized.

In conclusion, the activity rhythms are in some cases regular (but not accurately dependent or accurately persisting) and in other cases irregular. The senior author had previously supposed that as the environmental light periodicity becomes more and more discrepant from the normal one, so the activity may become more and more independent of the environment and persistent of the original rhythm. But the results of the present experiments did not prove it. At extremely shifted environmental conditions the activity was generally disturbed, being discordant from the normal rhythm, though usually showing deeply-rooted persistency to it. These results, of course, will be more or less modified according to the intensities of light to be used, but the general conclusion will be held. These circumstances can also be seen when the durations of the environmental cycles are shortened.

c) Activities under alternative 3 hours illumination and 3 hours darkness (on cycle 6 hours)

The experiment was performed during July 20 to 24, 1952, using 2 colonies, and repeated during July 13 to 18, 1953, using 4 colonies. The intensity of light used was 1470 Lux, the water temperature varied between 26.0° to 28.5° and 25.0° to 26.6°C respectively. The results are shown in Figs. 3a and b.

The colony No. 1 has a tendency to persist 24 hours rhythm, though, as may be judged from the irregular behavior during the expansion period, seems strongly influenced by the environmental 6 hours cycle. The behavior of No. 2 is irregular. No. 3 shows 12 hours cycle. No. 4 exhibits somewhat 6 hours cycle, being dependent on the environmental light periodicity. No. 5 resembles to No. 1, i.e., shows 24 hours cycles, though greatly modified by the environmental light periodicity; in other

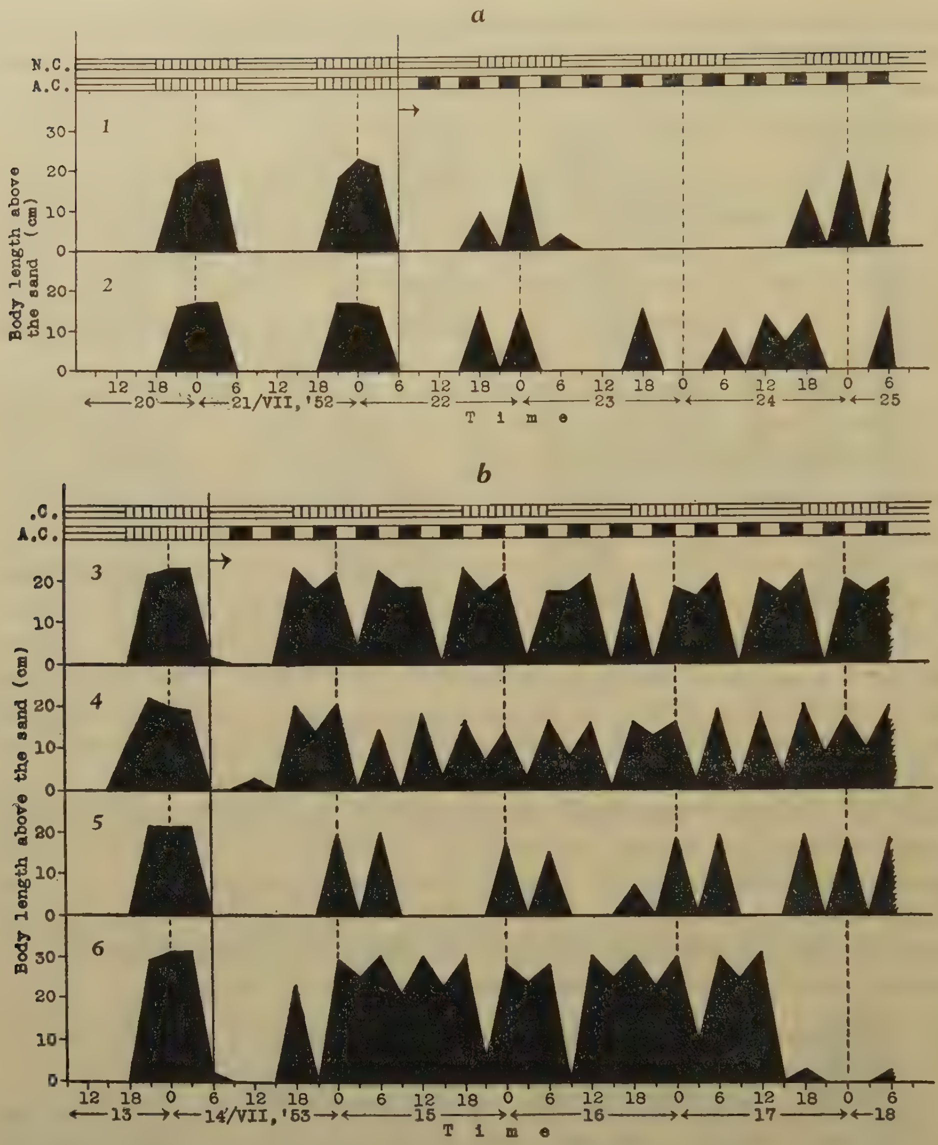


Fig. 3. Features of activity under 3–3 hours light-dark condition.
a shows the results obtained in 1952 and *b* shows those obtained in 1953.

words the intrinsic behavior of 24 hours' physiological rhythm is superimposed by the activities caused by the 12 hours' experimental light periodicity. No. 6 becomes irregular, being perfectly disturbed in its rhythmicity.

d) Activities under alternative 1.5 hours illumination and 1.5 hours darkness (one cycle 3 hours)

The experiment was performed during July 25 to 29, 1954, using 4 colonies.

The intensity of light used was 1000 Lux, the water temperature varied between 24.8° to 27.3°C. The results are illustrated in Fig. 4.

The activity rhythm of the colony No. 1 is of nearly normal 24 hours cycle. The rhythms of Nos. 2, 3 and 4 become disturbed after 2 days in the experimental environment. Among them, No. 2 is strongly disturbed; Nos. 3 and 4 show somewhat 3 hours cycle. It is clear, whenever, that the intrinsic rhythm and the extrinsic factors are more or less coacting together, thus giving peculiar features to the activity.

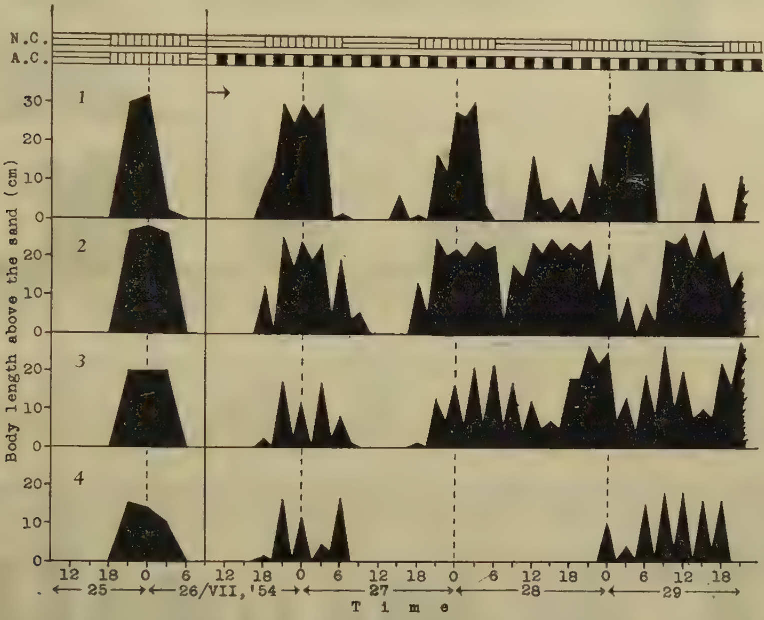


Fig. 4. Features of activity under 1.5-1.5 hours light-dark condition.

e) Activities under alternative 30 minutes illumination and 30 minutes darkness (one cycle 1 hour)

The experiment was performed during July 31 to Aug. 4, 1954, using 4 colonies. The intensity of light used was 1000 Lux, the water temperature varied between 25.4° to 27.4°C. The results are illustrated in Fig. 5.

The modes of activities of Nos. 1 and 4 resembled to the normal type. Those of Nos. 2 and 3 are greately disturbed. In this case, the superimposition of the externally originated rhythm upon the intrinsic 24 hours rhythm is not so conspicuous as in the cases of c) or d). This may be due to the fact that too frequent an alternation of environmental light and darkness is beyond the synchronizing ability of the animal.

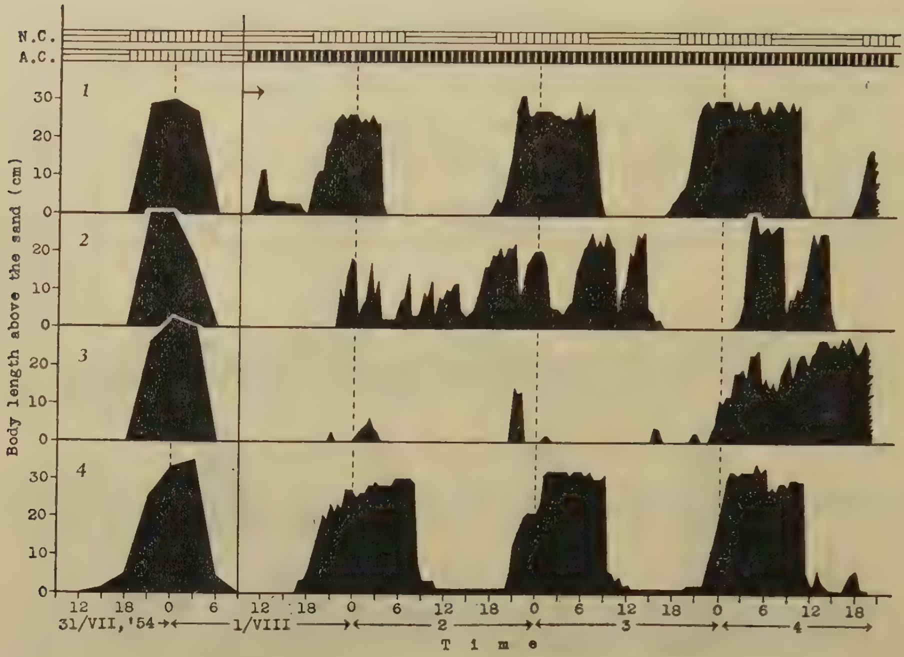


Fig. 5. Features of activity under 30–30 minutes light-dark condition.

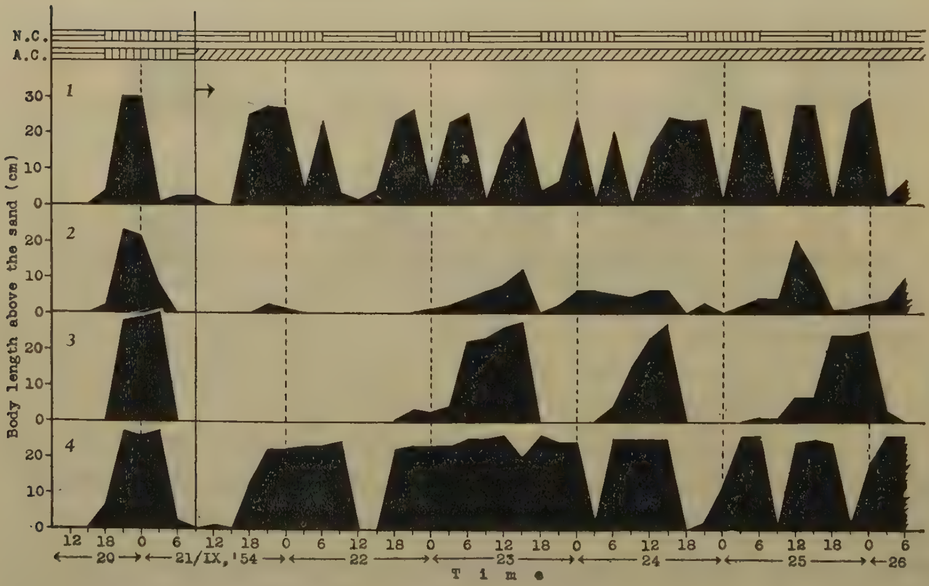


Fig. 6. Features of activity under 15–15 minutes light-dark condition. Period of experiment is indicated by oblique lines in the A.C. column.

f) Activities under alternative 15 minutes illumination and 15 minutes darkness (one cycle 30 minutes)

The experiment was performed during Sept. 20 to 25, 1954, using 4 colonies. The intensity of light used was 1200 Lux, the water temperature varied between 24.3° to 27.7°C. The results are shown in Fig. 6.

The mode of activity of No. 1 is peculiar, showing somewhat 9 to 12 hours rhythm. Nos. 2 and 3 are irregular, though showing a trace of 24 hours rhythm. No. 4 is perfectly irregular. It must be noted that there is no sign of direct superimposition of the environmental periodic phases upon the behavior rhythm.

g) Activities under alternative 5 minutes illumination and 5 minutes darkness (one cycle 10 minutes)

The experiment was performed during Aug. 28 to Sept. 3, 1955, using 3 colonies. The intensity of light used was 1400 Lux, the water temperature varied between 26.7° to 28.1°C. The results are illustrated in Fig. 7.

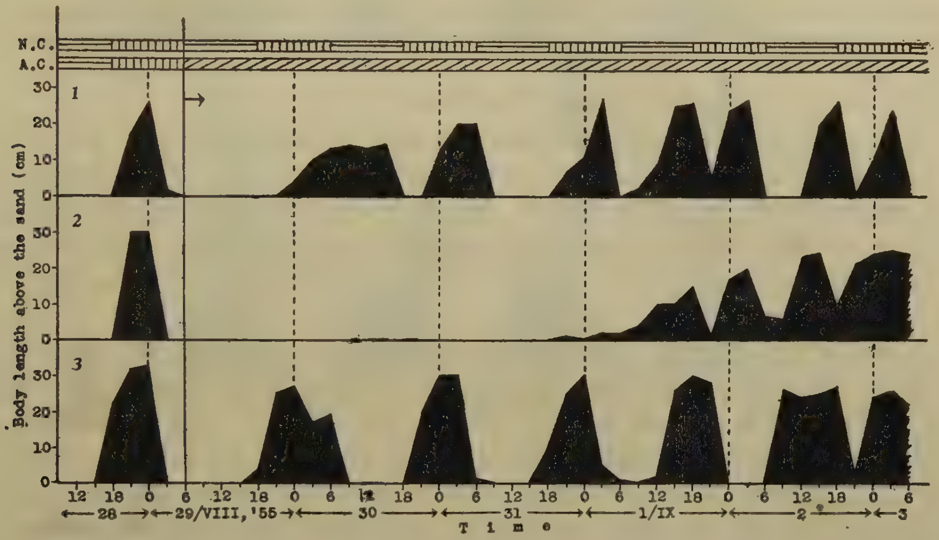


Fig. 7. Features of activity under 5–5 minutes light-dark condition. Period of experiment is indicated by oblique lines in the A.C. column.

No. 1 shows modified 12 hours rhythm. No. 2 is irregular, or having a trace of 12 hours rhythm. No. 3 persists 24 hours rhythm at first, but soon becomes irregular. Thus no colonies show either 24 hours rhythm or environmentally dependent rhythm. They are disturbed or show modified 12 hours rhythm. It is characteristic in this case that the periods, during which the animals contract perfectly beneath the sand, become shorter with the elapse of days, and this phenomenon may be taken as a sign of internal physiological abnormalities.

As mentioned in the paragraph b), the results of the experiments performed previously led the senior author to suppose that, under extremely shortened cycles of light and darkness the animal disregards the change of light and shows its original normal rhythmic behavior. Such, however, was not the case. The series of the experiments mentioned above indicate somewhat different results. Under extremely shifted rhythmic light conditions, no rule of rhythmicity was found in the behavior of the sea-pen, some being disturbed or made irregular, and others showing some sign of regular behavior but not of 24 hours rhythm. All these facts indicate that, under extremely shifted light conditions, the animal can neither adjust perfectly its internal physiological rhythm to the environmental periodicity, nor behave disregarding perfectly the environmental periodicity. The definite persistence of the original 24 hours rhythm, frequently observed under adequately shifted environments (such as 21–21 hours, 6–6 hours, or 3–3 hours light and dark conditions), may surely be based on the internal physiological rhythm, but we can not give at present any confident answer to the question, why this phenomenon is seen conspicucusly under moderately shifted periodic light conditions and not so clearly under slightly shifted conditions (such as 15–15 hours or 9–9 hours light and dark conditions) or under extremely shifted conditions as mentioned above.

2. The results of the second series of experiments

Only one set of experiment was planned, namely, the rhythmic activity under the 21 hours illumination and 3 hours darkness (one cycle 24 hours). The experiment was performed firstly during July 20 to 25, 1952, using 2 colonies, and repeated during July 13 to 18, 1953, using 4 colonies. The intensity of light used was 1470 Lux, the water temperature varied between 26.0° to 28.5°C and 25.0° to 26.5°C respectively. The results are illustrated in Fig. 8.

4 colonies out of 6 seem to persist their original 24 hours rhythm (Nos. 1, 3, 5 and 6), whereas 1 colony seems to bear a feature of 24 hours rhythm (No. 4), and the last 1 colony becomes irregular with the lapse of days (No. 2). Generally speaking, the tendency to persist the original rhythm is noticeable, that is the common characteristic seen in the results of the second series of experiments performed previously. This may be chiefly due to the fact that the sum of the illuminated and darkened hours is 24 hours.

3. The results of the third series of experiments

From the experiments mentioned above (1st and 2nd series of experiments), we can see a fair number of colonies persisting their original 24 hours rhythm, in spite of the subjection to abnormal periodic light and dark conditions. However, the periods during which the sea-pens are subjected to the experimental light conditions remain always within 3 to 5 days. Theoretically it is supposed that an animal can continue its perpetual life only when the internal physiological cycles go on in the same place with the environmental cycles. If so, the persisting activities described

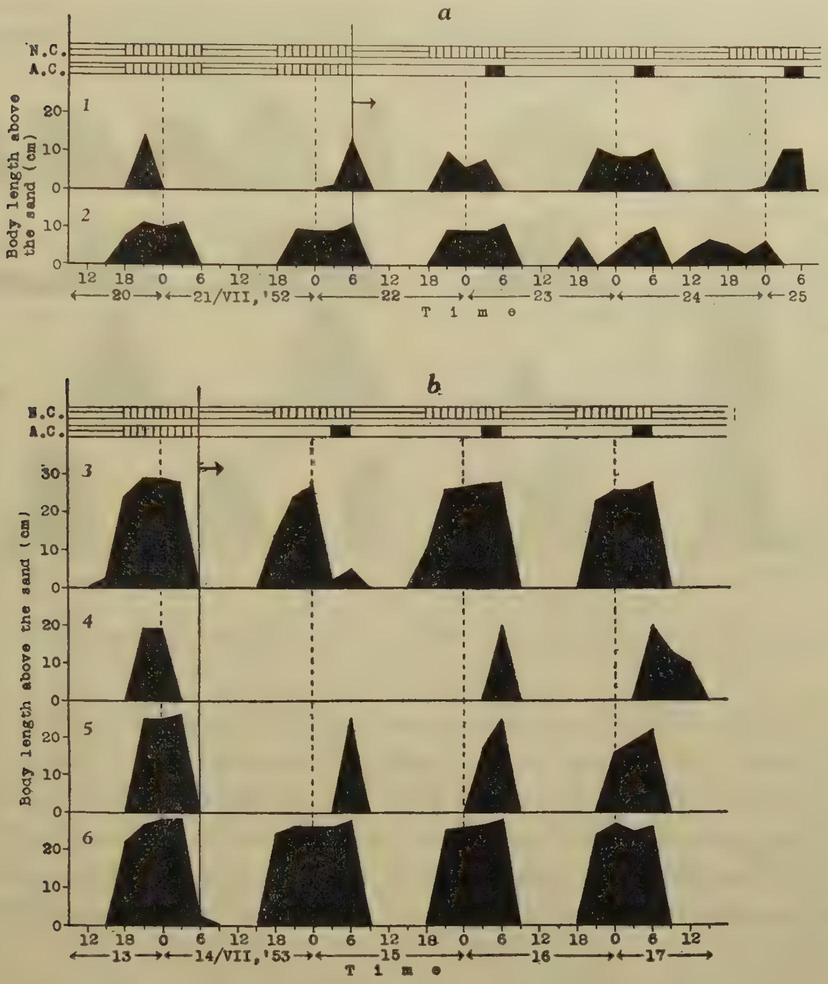


Fig. 8. Features of activity under 21–3 hours light-dark condition. *a* shows the results obtained in 1952 and *b* those obtained in the next year.

above may be due to the short duration of the experiments or may be said as of a false normality, and if we continue to subject them to abnormal light periodicities for longer times, the animals may be thrown into confusion.

From these considerations, we attempted to examine what might happen in the activity when the experimental operation of alternative 30 minutes illumination and 30 minutes darkness were continued for fairly a long time. The experiment was performed during July 17 to 28, 1955, using 4 colonies. The intensity of light used was 1200 Lux, the water temperature varied between 26.3° to 28.6°C. The results are illustrated in Fig. 9.

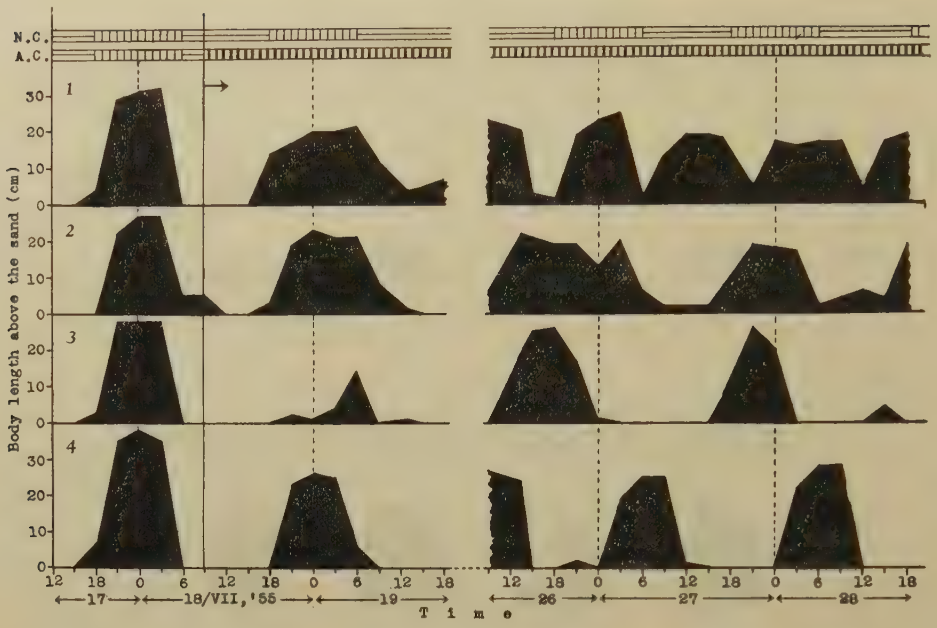


Fig. 9. Features of activity when subjected to 30–30 minutes light-dark condition for 10 days.

It is noted that 2 colonies out of 4 still persist their original 24 hours rhythm (Nos. 2 and 4) after 10 days in the experimental condition. No. 1 shows 12 hours rhythm and No. 3 27 hours rhythm. After all, the innate persisting nature is so firmly established that it can not be easily disturbed by such a treatment as this. Of course the fact that the influence of environment must not be ignored, is clearly demonstrated by the appearance of the colonies having abnormal rhythmic activities.

IV. Considerations

1. As has been mentioned in the Introduction, the daily rhythmic activity of *Cavernularia* is controlled by double factors, namely, the environmental light factor (exogenous factor) and the internal physiological factor (endogenous factor). The senior author has tried since 1943 to clarify the relations existing among these factors and the rhythmic behaviors, and has published several works (see Introduction). This report belongs to the category of works treating the relation between the environmental light factor and the rhythmic behavior.

As the previous works has mostly been published in Japanese, we will summarize them with additions of the present new results (Tables 1, 2 and 3).

Table 1. Rhythmic activities of *Cavernularia obesa* under alternative light and dark conditions of equal duration.
(Modified from MORI, 1950, with new data)

Environmental condition			Number of colonies	Date	Activity
Periodicity of light	Illumination intensity (Lux)	Range of water temperature (°C)			
24–24 periodicity (alternative 24 hours illumination and 24 hours darkness; one cycle 48 hours)	1400	26.7～28.1	3	Aug. 28 ～ Sept. 3 (1955)	Synchronization of rhythmic activity to light-dark cycle is generally imperfect. (1 shows modified 48 hours, 1 shows modified 24 hours, and the other shows irregular rhythm)
21–21 periodicity (one cycle 42 hours)	1400	24.3～27.7	4	Sept. 20 ～ 26 (1954)	Synchronization generally imperfect and some shows tendency to persist 24 hours rhythm. (2 are irregular or show rather modified 42 hours rhythm; 1 quite irregular; the other shows strong persistency to 24 hours rhythm)
18–18 periodicity (one cycle 36 hours)	1230	27.2～29.4	4	Sept. 7 ～ 15 (1943)	Synchronization generally imperfect. (1 is synchronized; the other 3 show two active phases during a dark period)
15–15 periodicity (one cycle 30 hours)	1230	26.0～28.8	4	Aug. 5 ～ 11 (1943)	Synchronization generally perfect.
9–9 periodicity (one cycle 18 hours)	1050	27.6～29.4	4	Sept. 5 ～ 13 (1942)	Synchronization generally perfect.
6–6 periodicity (one cycle 12 hours)	1050	19.6～22.9	4	Oct. 12 ～ 19 (1942)	2 colonies show modified 12 hours rhythm, the rest 2 show tendency of persisting 24 hours rhythm.
3–3 periodicity (one cycle 6 hours)	1470	26.0～28.5	2	July 20 ～ 25 (1952)	Synchronization generally imperfect. (1 synchronized, 1 shows 12 hours rhythm, 2 show 24 hours rhythm, and the rest 2 are irregular. In all cases, superimposition of environmental periodicity upon endogenous rhythm is conspicuous)
	1470	25.0～26.6	4	July 13 ～ 18 (1953)	
1½–1½ periodicity (one cycle 3 hours)	1000	24.8～27.3	4	July 25 ～ 29 (1954)	Synchronization generally imperfect. (Intrinsic behavior is always intensely superimposed by extrinsic periodicity; 1 shows tendency of persisting 24 hours rhythm, others are disturbed)
½–½ periodicity (one cycle 1 hour)	1000	25.4～27.4	4	July 31 ～ Aug. 4 (1954)	Synchronization generally impossible. (2 showing 24 hours rhythm, others are disturbed; superimposition is imperfect)
¼–¼ periodicity (one cycle 30 minutes)	1200	24.3～27.7	4	Sept. 20 ～ 25 (1954)	Synchronization perfectly impossible. (1 shows 9–12 hours rhythm, 1 is irregular, and the other 2 shows trace of 24 hours rhythm)
1/12–1/12 periodicity (one cycle 10 minutes)	1400	26.7～28.1	3	Aug. 28 ～ Sept. 3 (1955)	Synchronization perfectly impossible. (1 persists 24 hours rhythm, 1 irregular, and the rest 1 shows somewhat 12 hours rhythm)

Table 2. Rhythmic activities of *Cavernularia obesa* under alternative light and dark condition of different duration, one cycle of which was 24 hours. (Modified from Mori, 1950, with new data)

Environmental condition			Number of colonies	Date	Activity
Periodicity of light	Illumination intensity (Lux)	Range of water temperature (°C)			
21–3 periodicity (alternative 21 hours light and 3 hours darkness)	1470	26.0∼28.5	2	July 20 ∼ 25 (1952)	Synchronization impossible. (Generally persist original 24 hours rhythm; 1 becomes irregular)
	1470	25.0∼26.5	4	July 13 ∼ 18 (1953)	
18–6 periodicity	1200	19.0∼22.2	4	Oct. 27 ∼ Nov. 5 (1944)	Synchronization generally impossible. (1 is imperfectly synchronized; others are more or less disturbed, though showing deeply rooted tendency of persisting original day-night rhythm)
15–9 periodicity	1700	26.5∼29.0	4	Aug. 4 ∼ 7 (1944)	Synchronization perfect.
9–15 periodicity	1200	19.7∼21.0	5	Nov. 1 ∼ 5 (1944)	Synchronization perfect.
6–18 periodicity	1200	27.0∼29.0	3	Aug. 23 ∼ 29 (1946)	Synchronization somewhat imperfect. (Colonies do not stay in expanded condition through whole period of darkness but contract in the course, and it may safely be said that general features of activity resemble the normal rhythmic activity; some show irregular activity occasionally)
3–21 periodicity	1200	21.1∼23.5	3	Oct. 12 ∼ 18 (1946)	General features are similar to 6–18 periodicity.

Table 3. Reversal of activity rhythm of *Cavernularia obesa* by alternative 12 hours light of various illumination intensity and 12 hours darkness. (Modified from Mori, 1950)

Environmental condition		Number of colonies	Date	Activity
Illumination intensity (Lux)	Range of water temperature (°C)			
1230	27.6–29.5	4	Sept. 5–13 (1942)	Reversal completes within 2 days.
130	19.6–22.9	4	Oct. 12–19 (1942)	Reversal completes within 2 days.
7	19.3–24.2	4	Oct. 17–24 (1943)	Reversal completes within 2.5 days.
1.2	26.3–29.0	5	Aug. 4–11 (1944)	Reversal completes generally within 6 days, but 1 colony persists original normal rhythm.
0.3	26.5–28.2	4	Aug. 23–31 (1944)	2 colonies reverse their activity phase within 7 days; 1 shows rhythm of 15 hours quiescence and 21 hours activity, and the other is irregular.

Various data cited in Tables 1 and 2 may be schematically represented as Fig. 10.

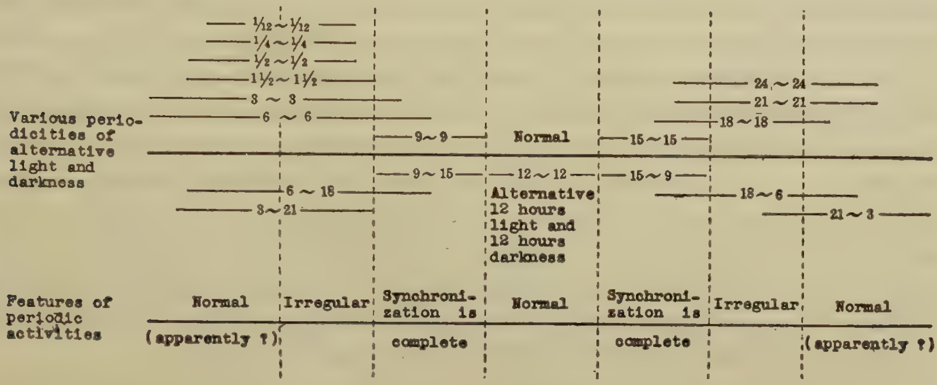

Various periodicities of alternative light and darkness
1/12 ~ 1/12
1/4 ~ 1/4
1/2 ~ 1/2
1½ ~ 1½
3 ~ 3
6 ~ 6
9 ~ 9
Normal
15 ~ 15
24 ~ 24
21 ~ 21
18 ~ 18
6 ~ 18
3 ~ 21
9 ~ 15
12 ~ 12
Alternative 12 hours light and 12 hours darkness
15 ~ 9
18 ~ 6
21 ~ 3
Features of periodic activities
Normal (apparently ?)
Irregular
Synchronization is complete
Normal
Synchronization is complete
Irregular
Normal (apparently ?)

Fig. 10. Features of activities, with variable ranges, exhibited under various periodicities of environmental light and darkness, summarized from Tables 1 and 2.

Some interesting points may be seen in these Tables and Figure.

A. Firstly, when the lengths of alternative light and dark periods are made equal with each other, features of rhythmic activities become different as the lengths of light-dark cycles vary. The perfect synchronization may occur only when one cycle is restricted within the range of 18 to 30 hours, and if the length of a cycle outsteps beyond this range, irrespective of longer or shorter side, the synchronization becomes gradually imperfect, and some animals even show normal (at least apparently) rhythmic behavior. This tendency of exhibiting the normal rhythm is seen most obviously under alternative 6–6 or 3–3 hours environmental periodicities; but as a cycle becomes shorter, activity of most animals shows irregular or particular rhythms (such as 9 or 12 hours cycles). The circumstance is somewhat different at a longer environmental cycle. Although, in this case also a few colonies persist the normal day-night rhythm, general features are somewhat different in comparison with those under a shorter environmental cycle. Most colonies behave irregularly or exhibit particular rhythms, though manifesting an intense tendency of persisting the normal rhythm.

We can find some papers which treat rhythmic activity under shortened or lengthened environmental light cycles than the normal day-night cycle. HARTMAN (1932), using a rhesus monkey *Macacus rhesus*, whose chief activity could be seen in the forenoon, established 12 hours rhythm by alternating 6 hours light period and 6 hours dark period (from CALHOUN, 1946). According to KALABUCHOV (1940), it took a transition period of about 10 days to induce a monkey to sleep in the 6 hours dark period and to be active in the 6 hours light period (from CALHOUN, 1946). HEMMINGREN and KRARUP (1937) attempted to establish in a white rat a 16–hours–day in which an 8 hours dark period alternated with an 8 hours light period.

Concerning 3 adult females under this light regimen, they said that "even after two months, a struggle was still going on between the tendency to display the activity in the dark period and the tendency to have one pronounced period of activity once every 24 hours" (from CALHOUN, 1946). BROWMAN (1943) also attempted to establish a 16 hours rhythm in a white rat aged 40 days. 2 females and 1 male each that had been born and raised in (a) constant light, (b) constant darkness, and (c) normal day-night conditions, were used. The parents of these rats had been subjected respectively to these conditions for 60 days before the birth of the young. All young which had been raised to day 40 in constant light adapted to 16 hours day. When they were raised under constant darkness, 1 out of 3 adapted 16 hours day, the other 2 retained 24 hours rhythm (although from time to time they showed 16 hours rhythm). The rats raised under normal conditions developed 24 hours rhythm, though at times showed 16 hours rhythm (from CALHOUN, 1946).

The prairie meadow mouse, *Microtus ochrogaster*, was subjected, by CALHOUN (1945), to consecutive 7 light-darkness cycles consisting of 24 hours of darkness followed by 24 hours of light (25 ft. c). Upon analysis of the results, it was found that both 24 hours and 48 hours rhythms of activity were in operation. The 24 hours rhythm was definitely superimposed upon the altered activity rhythm under the 48 hours "day".

As for the physiological rhythm, KLEITMAN and KLEITMAN (1953) stated that the pulsation rhythm of a man was made adapted more easily to 18 hours cycle than the temperature rhythm (from ASCHOFF, 1955).

Recently, German investigator TRIBUKAIT (1954) had subjected the mouse to various lengths of light-dark cycles—viz. 23 hours cycle (alternative 11.5 hours light and 11.5 hours dark), 22 hours cycle, 21 hours cycle, 20 hours cycle and 19 hours cycle. This animal had two activity peaks during a night, the primary one occurring just after the sunset and the secondary one just before the sunrise. This normal mode of activity was observed under longer cycles than 22 hours periodicity, but the time of the primary activity shifted gradually towards the secondary peak as the length of a cycle was shortened, uniting at last into one. This state could be observed at 21 hours light-dark periodicity, and in a shorter period than this the activity was disturbed (e.g. at 20 hours periodicity). Under a much shorter "day", the rhythmic activity reappeared, but in this case the rhythm was "normal", i.e., 24 hours "day". TRIBUKAIT considered that the secondary peak was dependent directly on the environment, whereas the primary peak was endogenous. It must be noticed that under modified environment, the endogenous one disappears firstly, and again reappears under intensely modified conditions. This conclusion recalls us the results of activities of our sea-pens. When a "day" was shortened, the sea-pen was at first synchronized with the environmental periodicity, but as the modification of the environment became greater, the irregularity of activity grew larger, and the number of colonies persisting normal 24 hours rhythm became larger. In this animal, however, under extraordinary shifted conditions, the persistency of 24 hours rhythm became again weakened.

YAMAZAKI (1955) studied recently the egg laying activity of a moth, *Antheraea pernyi*, which deposited eggs at night in nature. When subjected to the alternative 1 hour light (100 Lux) and 1 hour darkness, it layed eggs only in the dark, but when subjected to the alternative 10 minutes light and 10 minutes darkness, the rhythm was disturbed and the egg-laying behavior was ceased. Though the alternative periodicity is shorter in this experiment, the general feature has some resemblance to the case of the sea-pen.

B. Secondly, when the relative length of light and dark hours are changed, maintaining the total length as 24 hours, modes of activity change according to the different length of light hours. When it is shorter than 12 hours, the synchronized rhythmic activity can easily be established, though the sea-pen does not expand throughout the dark period. In other words, the sub-normal activity is exhibited under these circumstances. On the contrary, when the light hours are lengthened, the synchronization becomes difficult gradually, irregularity in behavior getting markedly, and at last the endogenic rhythm gains more and more its force.

Now let us see the literature. ASCHOFF and MEYER-LOHMANN (1955a, b) published the works concerning this category of experiment. They employed some rodents (mouse and rat) and a passerine bird (*Chloris chloris*). By subjecting mice to alternative 6 hours light (300 Lux) and 18 hours dark cycle or 18 hours light and 6 hours dark cycle, the conspicuous endogeneity was demonstrated. As above mentioned, this animal shows two activity maxima during night, the interval of which is about 15.5 hours in the ordinary "day". In the experimental "day", in which the length of light hours was shortened or lengthened by 6 hours, the interval of rest was shortened or lengthened by about 1.5 hours only. They also measured the amount of activity, and found that it reached a maximum when lighted hours were 14 to 16 hours per day, and in cases of longer or shorter lighted hours than these the amount was decreased. In the passerine bird, they changed the lighted hours (300 Lux) per day as 10, 8, 6 or 4 hours respectively, and measured the amount of activity. The highest activity per light hours and the highest total activity per 24 hours was found respectively under 8 lighted hours per day and 12 lighted hours per day. This bird showed two activity peaks during daytime, the prime maximum in the morning and the ancillary maximum in the evening. Although the both maxima had the endogenous component of rhythmicity, only the prime maximum was the inalienable constituent. The ancillary maximum fluctuated individually or from day to day, and was more determined by clues. The time displacement of the maxima to each other was limited.

After all, we have an opinion that, as the environmental light-dark periodicity shifts from the normal day-night cycle, the activity rhythm at first synchronized with the changed environmental periodicity, but the original endogenous rhythm gradually gains its power, and at last under extraordinary conditions disturbance of the rhythm becomes conspicuous. Of course, the absolute length of light and dark hours that causes various modifications in the activity rhythm differs with the applied intensity of illumination.

C. Thirdly, the influence of illumination intensity on the reversal of rhythm shall be considered. It will be natural that, stronger the intensity, easier the accomplishment of the reversal. By the way, it must be noticed that even so feeble a light such as 0.3 Lux may reverse the rhythm. Brown, Fingerman and Hines (1954) studied the mechanism of reversal of daily rhythm in color change of the fiddler crab, *Uca pugnax*, by illumination by night and darkness by day. The animals were subjected to a series of combination of illumination by night (19–7 o'clock) and dimmer illumination by day (7–19 o'clock). Some of their results are as follows. When illuminated by 100 ft. c. by night and kept in total darkness by day, complete reversal was observed. When illuminated by 25 ft. c. by night and by 2 ft. c. by day, shift of phase by about 6 hours was observed after 5 days of exposure. Whereas when illuminated by 50 ft. c. by day, no change in the phase was observable. They concluded that, "a graded series of amount of shift was obtained which was capable of being interpreted in terms of two operating factors: (a) the strength of the stimulus in the form of the dark to light change, and (b) the absolute brightness of the higher illumination." Although this work is concerned with the physiological rhythm, we think that the conclusion may be applicable to the behavior rhythm. Indeed, Mori (1945a) has already pointed out that both absolute values of environmental factors and grades of shifting (or relative values) of these factors must be taken into consideration in the analysis of daily rhythmic activity in general.

2. As has been mentioned, the behavior rhythm of an animal is strongly influenced by the periodicity of environmental factors, but it is also true that another base for the behavior rhythms is given by the internal physiological rhythm. From this point of view the senior author and/or his colleague have been making effort to clarify the metabolic processes taking place in the course of a day (refer to Mori, 1944a and c, 1950; Takada and Mori, 1956, 1957). In this report, however, we will not discuss about these metabolic rhythms, but we will note here that investigators of this sort of phenomena should not ignore this point.

V. Summary

1. The sea-pen, *Cavernularia obesa*, has on one hand, a marked tendency to persist its normal daily rhythm of activity under shifted light conditions, but on the other hand the light influences considerably its mode of activity. This report concerns with the modifications of the activity under various abnormal day-night cycles. The illumination intensity used in the experiments ranged between 1000–1700 Lux (mostly about 1200 Lux).

2. When the alternative light and dark periods of equal lengths are applied,

features of the rhythmic activity differ with the lengths of the environmental light-dark cycles. The perfect synchronization is seen only when a cycle of the environmental light periodicity is restricted within 18 to 30 hours, and if the period of a cycle is beyond these ranges, irrespectively longer or shorter, the synchronization becomes gradually imperfect, and some animals even show "normal" (at least apparently) rhythmic behavior. This tendency is seen most obviously under alternative 6-6 or 3–3 hours environmental periodicities, and as a cycle becomes shorter, the activity of most animals falls into an irregular or a particular rhythm (such as 9 or 12 hours rhythms). The circumstances are somewhat different at a longer environmental cycle. Although, in this case too, some colonies persist their normal day-night rhythm, the feature is rather different in comparison with that under a shorter environmental cycle. Most colonies become irregular or exhibit particular rhythms, though manifesting a strong tendency of persisting the normal rhythm.

3. When the relative length of light and dark hours is changed, maintaining the total length as 24 hours, modes of activity become different according to the light hours are lengthened or shortened. When they are shortened than 12 hours, the synchronized rhythmic activity can easily be established, though the sea-pen does not expand through all the time of dark period. Viewing from a different point, it can be said that the sub-normal activity is exhibited under these circumstances. On the contrary, when the light hours are lengthened, the synchronization becomes difficult, irregularity getting conspicuous, and the endogeneity gains more and more its force.

4. Some literature were considered comparing with our results.

5. It was pointed out that in the study of daily rhythmic activity we must recognize the importance of the approach from two sides, one from the environmental control and the other from the internal physiological control.

LITERATURES CITED

Aschoff, J. 1954. Zeitgeber der tierischen Tagesperiodik. Naturwiss., 41, 49–56.

——————— 1955. Exogene und endogene Komponente der 24 Stunden-Periodik bei Tier und Mensch. Naturwiss., 21, 569–575.

——————— & Meyer-Lohmann, J. 1955a. Die Aktivitätsperiodik von Nagern im künstlichen 24-Stunden-Tag mit 6–20 Stunden Lichtzeit. Z. vergl. Physiol., 37, 107–117.

——————— & ————————— 1955b. Die Aktivität gekäfigter Grünfinken im 24-Stunden-Tag bei unterschiedlich langer Lichtzeit mit und ohne Dämmerung. Z. Tierpsychol., 12, 254–265.

Browman, L. G. 1943. The effect of bilateral optic enucleation upon the activity rhythms of the albino rat. J. Comp. Psychol., 36, 33–46.

Brown, F. A., Jr., Fingerman, M. and Hines, M. N. 1954. A study of the mechanism involved in shifting of the phases of the endogenous daily rhythm by light stimuli. Biol. Bull., 106, 308–317.

Calhoun, J. B. 1944–1946. Twenty-four hour periodicities in the animal kingdom. J. Tennessee Academy of Sci., 19 20.

——————— 1945. Diel activity rhythms of the rodents, *Microtus ochrogaster* and *Sigmodon hispidus hispidus*. Ecol., 26, 251–273.

HARTMAN, C. G. 1932. Studies in the reproduction of the monkey, *Macacus* (*Pithecus*) *rhesus*, with special reference to menstruation and pregnancy. Carnegie Institution Wash., Contributions to Embryology, 23, 1–162.

HEMMINGSEN, A. M. and KRARUP, N. B. 1937. Rhythmic diurnal variation in the oestrous phenomena of the rat and their susceptibility to light and dark. Biol. Meddel. Kobenh., 13, 1–64.

KALABUCHOV, H. N. 1940. The study of the 24-hour cycle of activity of animals. Uspekhi Sovrennoi Biologii, 12, 1–24.

KLEITMAN, N. 1949. Biological rhythms and cycles. Physiol. Rev., 29, 1-30.

MORI, S. 1945a. General considerations on the relations between behavior rhythms of animals and periodicities of their environmental factors. Kyodai Seiri Seitai, 39. (in Japanese)

——— 1947a. A concept on mechanisms of the endogenous daily rhythmic activity. Mem. Coll. Sci., Univ. Kyoto, Ser. B, 19, 1–4.

——— 1948a. Harmony between behavior rhythm and environmental rhythm. Ibid., 71–74.

——— 1948b. Rhythmic activities of animals. Hoppô Syuppan Sya. Sapporo. (in Japanese)

——— 1943a. Daily rhythmic activity of the sea-pen, *Cavernularia obesa* Valenciennes. I. Observations in nature. Zool. Mag., 55, 285-291. (in Japanese)

——— 1943b. do. II. Activities under constant darkness and constant illumination. Ibid., 55, 247–253. (in Japanese)

——— 1944a. do. III. Controlling of the activity by light. Ibid., 56, 81–85. (in Japanese)

——— 1944b. do. IV. Observations of the activity in winter. Ibid., 56, 86 90. (in Japanese)

——— 1944c. do. V. Activities under constant illumination and constant darkness in winter and influence of water temperature. Ibid., 56, 91–95. (in Japanese)

——— 1944d. do. VI. Analysis of the endogenous rhythm. (1). Ibid., 56, 96-100. (in Japanese)

——— 1944e. do. VII. Change of reaction to light through a night. Ibid., 56, 101–104. (in Japanese)

——— 1945b. do. VIII. Endogenous daily rhythmic activity. Kyodai Seiri Seitai., 19. (in Japanese)

——— 1947b. do. IX. Activities when kept long under constant darkness. Physiol. and Ecol., 1, 8–14. (in Japanese with English résumé)

——— 1949. do. XI. Controlling of the activity by light (2). Ibid., 3, 32–37. (in Japanese with English résumé)

——— 1950. do. XII. Conclusions—Problems on relations among environments, behaviors and internal physiological conditions. Ibid., 4, 12–20. (in Japanese with English résumé)

PARK, O. 1940. Nocturnalism—The development of a problem. Ecol. Monogr., 10, 485–539.

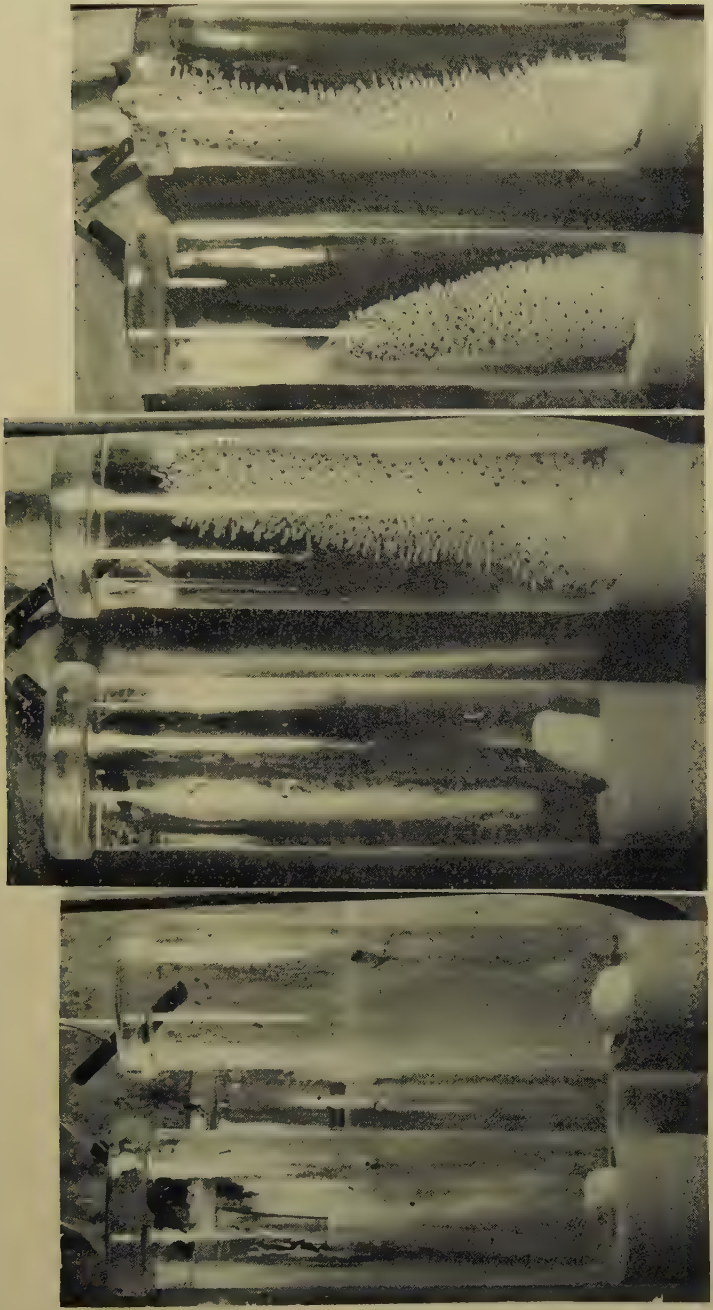
TAKADA, N. & MORI, S. 1956. Daily rhythmic activity of the sea-pen, *Cavernularia obesa* Valenciennes. XIII. Rhythmic change of ammonium content in body fluid. (1). Zool. Mag., 65, 359–361. (in Japanese with English résumé)

——— & ——— 1957. do. XIV. do. (2). In press. (in Japanese with English résumé)

TRIBUKAIT, B. 1954. Aktivitätsperiodik der Maus im künstlich verkürzten Tag. Naturwiss., 41, 92–93.

YAMAZAKI, H. 1955. Studies on the nervous control in the conduct of mating and oviposition of Lepidopterus moths. Bull. Nagano Sericultural Exp. Sta., 10, 197–242. (in Japanese)

PLATE V



EXPLANATION OF PLATE V

Various phases in activity of the sea-pen in glass cylinders are represented.

Left: animals are just beginning to expand above sand in the evening.

Middle: states about an hour later; animals are expanding.

Right: states again about an hour later; right animal is fully expanded.

S. MORI & Y. ONDÔ: DAILY RHYTHMIC ACTIVITY OF THE SEA-PEN, XV.

ECOLOGICAL OBSERVATIONS ON THE JAPANESE SPINY LOBSTER, *PANULIRUS JAPONICUS* (VON SIEBOLD), IN ITS LARVAL AND ADULT LIFE[1]

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With Plates VI–VII, 5 Tables and 6 Text-figures

Introduction

The Japanese spiny lobster, *Panulirus japonicus* (VON SIEBOLD), is one of the most dominant crustaceans on the Pacific coast of southern Japan. The spiny lobster fishery takes a most important part in the inshore fishery of this area during the open season of the winter through early spring.

The Japanese spiny lobster has been studied on the embryonic development by NAKAZAWA (1917), TERAO (1929), and SHIINO (1950); on its larvae by NAKAZAWA (1917), KINOSHITA (1934), OHSHIMA (1941), and OKADA and KUBO (1948, 1950); and in regard to its adult life by many authors, such as KINOSHITA (1931, 1934), OHSHIMA (1935, 1941, 1948), NAKAMURA (1940), OKADA and KATÔ (1946), OKADA and KUBO (1946), OKADA, KUBO and TAKAGI (1947), KUBO and HATTORI (1947), INO (1947, 1950), etc. However, the ecological studies of the larvae are very scarce, and the true life of the adult might be expected to be made clear through direct observations under water, though the study along this line has not been fully developed yet owing to its practical difficulty.

Although its landing is not so great as of other marine food animals like fishes, cuttlefishes or prawns in this country, the species concerned is of considerable economic value in providing for the fishermen's income in certain areas. It has become desirable for the problem of conservation or increase of its natural stock to obtain a thorough knowledge of the life history of this animal, especially of the ecology of the larvae when recent development of the fishery using the fish-attracting lamp has brought a new problem into the coastal fishery. Many fishermen are convinced that the evil effect of intense light of the lamp on the larvae of the Japanese spiny lobster leads them to die and consequently results in the remarkable decrease of the adult population.

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The present paper deals with some aspects of lives of the larvae and the adult of the Japanese spiny lobster. The distribution of the larvae and the effect of the fish-attracting lamp upon the larvae were examined by the plankton sampling procedures in relation to the distribution and breeding of the adult lobster and the developmental stages of the larvae.

The present work was defrayed in part by a grant from the Foundation in Support of the Seto Marine Biological Laboratory to which I wish to express my hearty thanks. Furthermore, I am indebted to Professor Denzaburo MIYADI for his instructive advice and to Dr. Huzio UTINOMI for his guidance and suggestion given to me throughout the whole course of my investigation. Mr. Shinichiro FUSE and Mr. Ryônosuke OKUNO cared nothing about to give advice and to help me in the field investigation, to whom my sincere thanks are due. To Mr. Syûzi URA and Mr. Syôzô SAKAI, I am especially grateful for the practice of the field work on board. Mr. Syôzô SAKAI also generously afforded his record of the catch of the spiny lobster to me. Lastly, I would like to extend my special thanks to Mr. Chiyozi KANAYA and Mr. Hidematsu TOYAMA for providing me with some samples of the larvae taken by them, and to Mr. Shigeru IWAHASHI for providing at my disposal with the facilities of examining the landing of the spiny lobster at the Sirahama Fishery Market.

Methods of Collecting and Study

The following observations were carried on during about one year and a half period from July, 1955 to January, 1957, in the neighbouring waters of the Seto Marine Biological Laboratory at Sirahama, Wakayama Prefecture.

With the purpose to observe the occurrence and distribution of the planktonic larvae of the species concerned, hauls were made using a large and a small plankton net. The large one was 1 m in diameter at the mouth and 2.6 m long with silk bolting cloth at the upper and middle part (29 meshes/inch) and at the bottom (39 meshes/inch). The net was entered into the water, and immediately hauled behind the research boat for 3 minutes duration with the constant speed, keeping it in such a position that the upper edge of the opening lies just beneath the water surface. The current meter was attached to the centre of its opening ring to be able to estimate the volume of water flowed into the net. A volume of about 78 m^3 of water was usually filtered at each haul. The small net was 0.5 m in diameter at the mouth and 1 m long with silk bolting cloth (39 meshes/inch). The net was usually hauled from the bottom to the surface during the 24-hour period on several occasions at two stations. On several occasions, a series of horizontal hauls at various depths were made using this net.

For the collection of the smaller larvae on and beneath the rocks or among the algae, the pump was used in summer-time, water pumped up being filtered at each time with silk bolting cloth (72 meshes/inch). In this case, the hose was kept by me under water with the aid of the "scuba". Direct observations and collections were made while diving with the "scuba".

To test the effects of the fish-attracting lamp on the larvae, the experimental lightings were made to capture the light-attracted larvae.

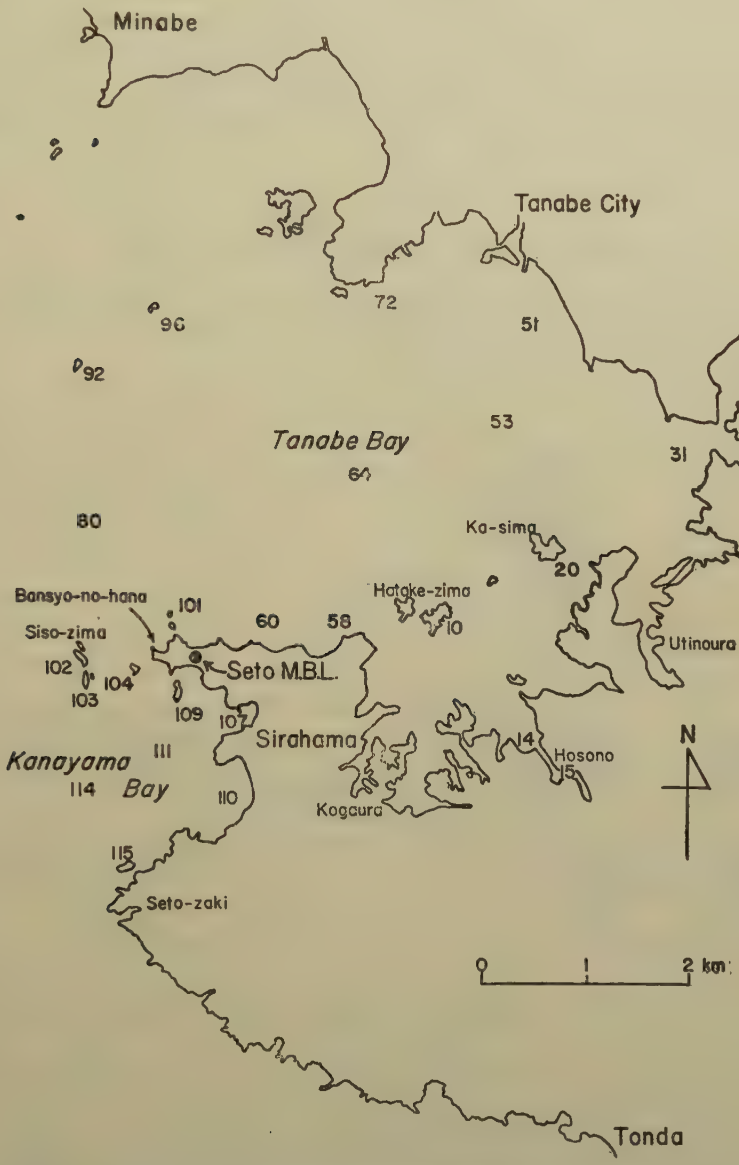
Minabe
Tanabe City
72
51
96
92
53
Tanabe Bay
64
31
80
Ka-sima
20
Bansyo-no-hana
101
Hatake-zima
Siso-zima
60
58
10
Utinoura
102
104
Seto M.B.L.
103
109
107
Sirahama
14
Hosono
15
N
Kanayama
111
114
Bay
110
Kogcura
115
Seto-zaki
0
1
2 km
Tonda

Fig. 1. Map of the area studied, showing stations mentioned in the text.

Several stations were chosen in Kanayama Bay, Tanabe Bay and off Bansyo-no-hana. Plate VI shows the area chiefly investigated. These stations are shown in Fig. 1 and Table 1 (p. 117).

The samples of the commercial spiny lobster landing were examined at the Sirahama Fishery Market as often as it was possible. The gear used for the commercial spiny lobster fishery is the anchor gill net, usually called "ebi-ami" in Wakayama Prefecture. The fishermen set the net at evening along rocky shores and reefs and pull it up next morning. The net with the mesh size of about 5 cm is commonly employed, but it may allow the escape of some smaller adult or subadult lobsters than of the legal size ("short"), although a considerable number of "shorts" are taken.

Distribution and Abundance of the Adult

Distribution. The Japanese spiny lobster ranges in rocky areas throughout the Pacific coast of southern Japan, northward to Ibaragi Prefecture.

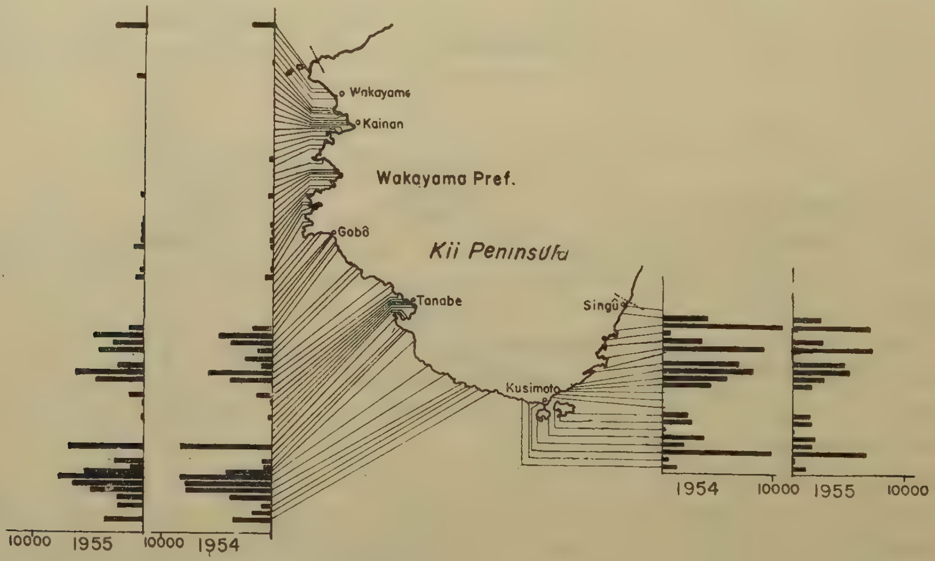

Fig. 2. Quantity per annum of spiny lobsters landed at each fishery market in Wakayama Prefecture, 1949–1950. Quantities are shown by their weight in kg.

All along the west coast of Kii Peninsula, the commercial spiny lobster fishery is effectively working as far north as Kada, facing the entrance to Osaka Bay. Fig. 2 shows the total landings of the spiny lobster at each fishery market during two years of 1949 and 1950. The total landing increases to its maximum as going southwards and this is likewise in the case of the catch per unit effort represented in terms of that per one fisherman. It must be noted that relatively high landings are represented at Kada, where the benthic fauna has rather southern characters. The remarkable difference in total landings between the areas northward and southward from Hino-misaki clearly indicates that the spiny lobster occurs in abundance in the southern areas directly washed by the warm current of Kurosio.

The daily average numbers of the catch per one fisherman at various fishing grounds near the Seto Marine Biological Laboratory are shown in Table 2. It seems reasonable to conclude from this data that the better yields are expected, in general, from where faced to the open sea of warm water than from in the bay throughout the whole commercial season.

The daily records of the number of the catch and the locality are highly useful to make clear the relative abundance and activity of the lobster. Localities where fishing nets were placed and the points where the lobsters were caught were recorded and plotted on the map every day by one fisherman, Mr. Syôzô SAKAI, when he fished during the commercial season from November, 1955, to April, 1956, except January, 1956. The data were available from the northern part of Kanayama Bay, which is for the sake of convenience divided into several regions topographically. Relative abundance in each region is presented monthly in Fig. 3 in terms of the average number of the catch per unit effort (i.e. per one sheet of the fishing net). Variations from region to region are apparent, being always low in the innermost part of the bay.

The similar tendency is noted in Tanabe Bay too. The spiny lobsters reduce their number considerably in the innermost part of the bay, where the rocky reefs are covered by mud and the water is generally shallower.

Habitat. Considering that rocky areas may hardly be said to be uniform environments and must afford various habitats, it seems that the lobsters are distributed in close relation to topographical features of underwater reefs or rocks. Moreover, they have a tendency to aggregate to a greater or less extent, as in the findings of LINDBERG (1955) for *Panulirus interruptus.* By diving at the point where one or two catches were recorded every day for four days, more than twenty lobsters wers found in a large rock cave. There were many holes or crevices available to them as shelters within 10 metres from this rock cave, but little were found there. Furthermore, some lobsters were utilizing small holes on the roof of the cave or small space under small boulders in the cave, whereas such holes were rarely utilized as their shelter in open areas with abundant habitats (Plate VII, figs. 1 & 2). On other occasions, three to five lobsters were observed for about one month of August, 1955, in a vertical rock crevice, the upper part of which was usually exposed to the air at the ebb tide. Almost the same number of lobsters were found there during the summer of the next year. On another occasion, as many as ten or twelve lobsters inhabiting in one large ledge were observed, and neighbouring smaller sheltering ledges were also occupied by lobsters. These facts suggest that lobsters tend to aggregate, but the aggregation of the lobster occurs in the way of utilizing every shelter in their neighbourings.

Seven diving localities were chosen in Tanabe Bay in November, 1956, to investigate the outer-inner distribution of the lobsters in relation to their habitat. At Station 102 (the outer side of the rocky reef of Sisô-zima), where the lobster fishing is intensively made, a number of lobsters were found at various situations, such as rock caves, sheltering ledges, small holes, rock crevices, or under boulders, and they were almost concentrated to small areas. At a reef (Kanatoko-zima) just north of Station 101, there was little rock crevice or rock cave along the cliff which extends downward to some 15 m depth from the sea surface, and consequently existed no or little lobster. Although sufficient available rock crevices, small caves, sheltering ledges, of holes

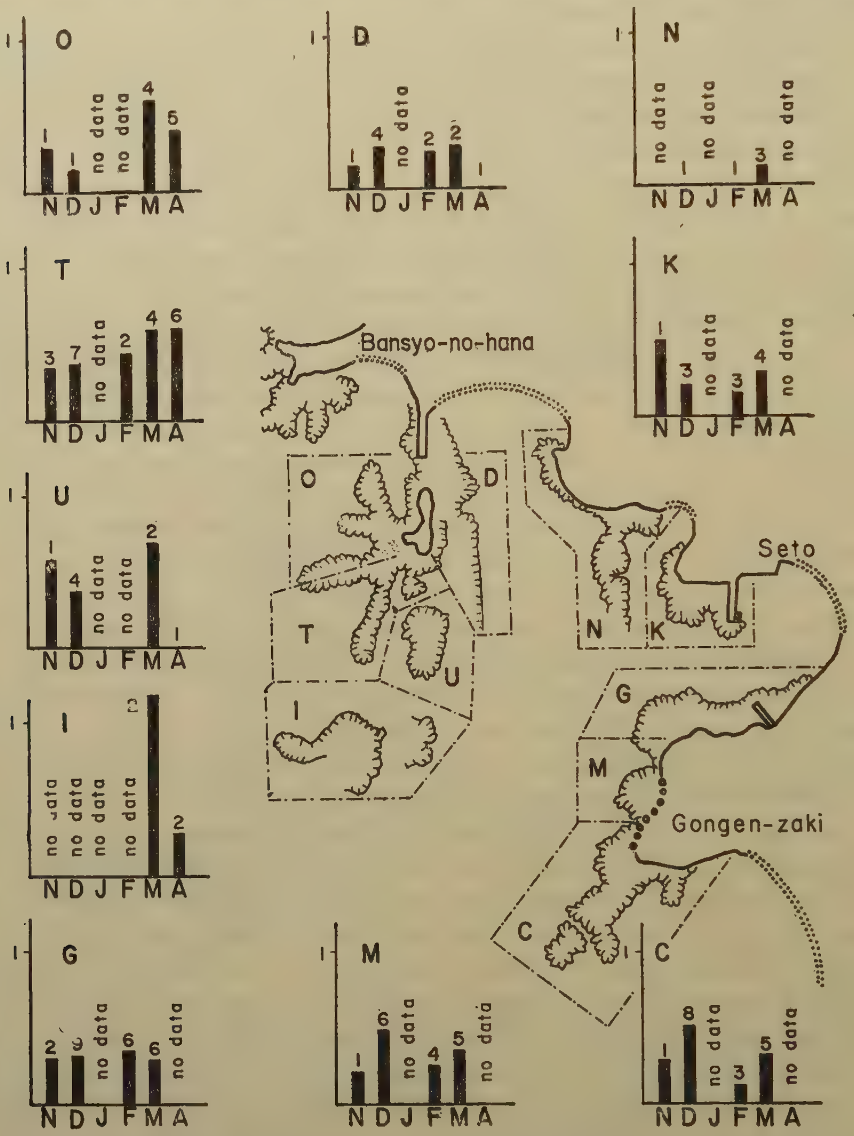

Fig. 3. Monthly average numbers of the catch per one sheet of fishing net in various regions of northern part of Kanayama Bay in the commercial season of 1949 1950, as recorded by one fisherman.

were afforded at the east side of Hatake-zima, which is in an area lightly fished, mud covered all over the bottom, and lobsters were aggregated and utilizing only deep caves, deep ledges or deep crevices, innermost parts of which had little mud covering. At Kanô-zima, which is situated between Hatake-zima and Ka-sima, the mud covering was thicker than at Hatake-zima, and only one lobster was found in a small hole. At innermost two localities of Utinoura and Kogaura, mud was deposited thicker and only one lobster was found in a small hole at the depth of 5 m at Utinoura.

The large population of the spiny lobster may be expected at somewhat offshore and deep reefs where various types of shelters are abundantly available and not at the innermost parts of the bay where mud deposits thicker.

Population Composition. A total of 2,444 lobsters were measured. The monthly frequency distribution of carapace length is shown in Fig. 4 by each 5 mm. The range is 21 mm to 112 mm. The minimum size of the catch is associated with the mesh size of the net, so it must be noted that data cited above does not provide random samples of the natural lobster community.

In general, there is a remarkable difference in the range of size between male and female, that is, large lobsters are mainly found in males. The number of the male also exceeds that of the females in every monthly sample.

It was hoped that the age groups would be indicated by a series of modes of the carapace length frequency, and that the successive progression of these modes month by month would indicate the average growth increment of the age groups. NAKAMURA (1940) and OHSHIMA (1941) have stated that there is a clear indication of two size groups in the frequency distribution of carapace length in the sample of August. One mode is at about 36 mm and the other is at about 52 mm. They also followed the shiftings of these modes over a year and decided that the former is of the two-years-old1) and the latter of the three-years-old2). For *Panulirus argus*, DAWSON and IDYLL (1951) detected a shifting of one mode of the length frequency indicative of annual growth, but the number and complexity of the modes failed them in identifying the various age groups and in tracing the growth rates of each. LINDBERG (1955) also was unable to show well-defined size groups in *Panulirus interruptus*. These are all the same as is the case of the present data. No well-defined size groups could be detected. One dominant mode is apparent in most of the months, shifting slightly to the right as the season progresses. Although KUBO and HATTORI (1947) say that the ecdysis never occur till May, the lobsters were found frequently in the state of just preparing the moult or in the soft-shelled condition after the moult. The shift of the mode may possible be the result of the growth.

Seasonal and Daily Variations. The monthly commercial landing records at the Sirahama Fishery Market between the years 1949 and 1950 are presented in

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1)2) OHSHIMA (1948) corrected thus in his paper later published.

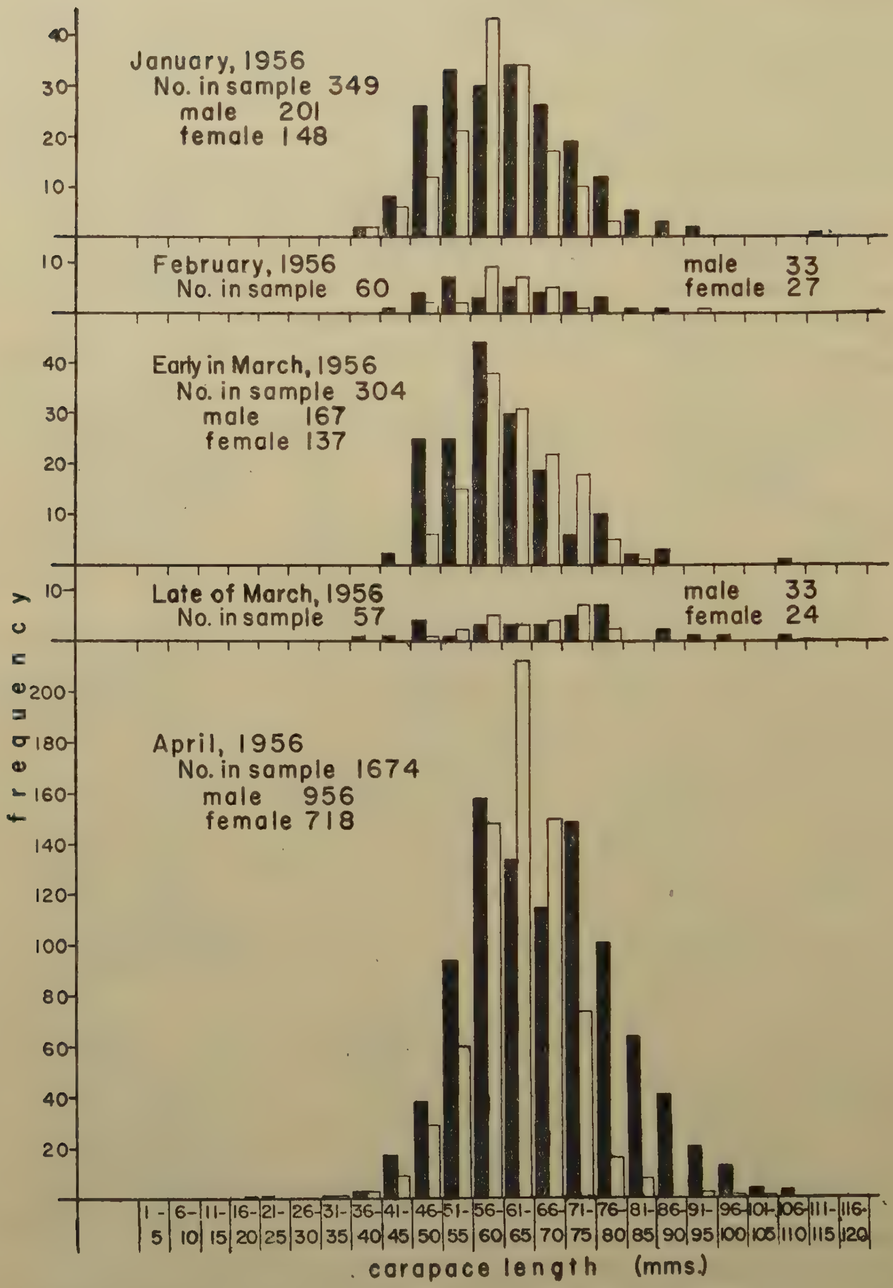

Fig. 4. Frequency distribution of carapace length in monthly samples from the catch landed at the Sirahama Fishery Market in the period from January to April, 1956.

Fig. 5. The landing diminishes considerably in the winter months of January and February, being followed by remarkable increases in the spring months of March and April. The same tendency is also shown in Table 2 and Fig. 3.

Daily yields vary much according to the condition of the sea. Fishermen say that heavy surge during night often yields a great catch. A possible explanation for this evidence may be that the lobsters are captured by the net swinging and pushed to them by the action of surge when they are out of their shelters. Full moon at night results in little or no yield (Table 2 and 3).

Migration and Activity. The evidence of migration of the spiny lobsters has been described by many authors for many members of the Family Palinuridae. OHSHIMA (1935) says for *Panulirus japonicus* that the lobsters migrate from deep water to shallow water in spring and that this is associated with the increase of water temperature. The same is said for *Jasus lalandii* by ANDERTON (1907). SMITH (1948) recognized three types of movement for *Panulirus argus*: 1) that caused by the change in physical condition, 2) that concerned with search for food, and 3) regular seasonal movements associated with breeding habits. DAWSON and IDYLL (1951), showing the sex ratios by month for the same species, reported that the proportion of female in the population is at its lowest point in the months at the height of the spawning season, presumably because they move into deeper water to spawn. By comparing the length frequencies and sex ratios at various localities, SUTCLIFFE (1952, 1953) also found for *Panulirus argus* that the great majority of mature females and smaller

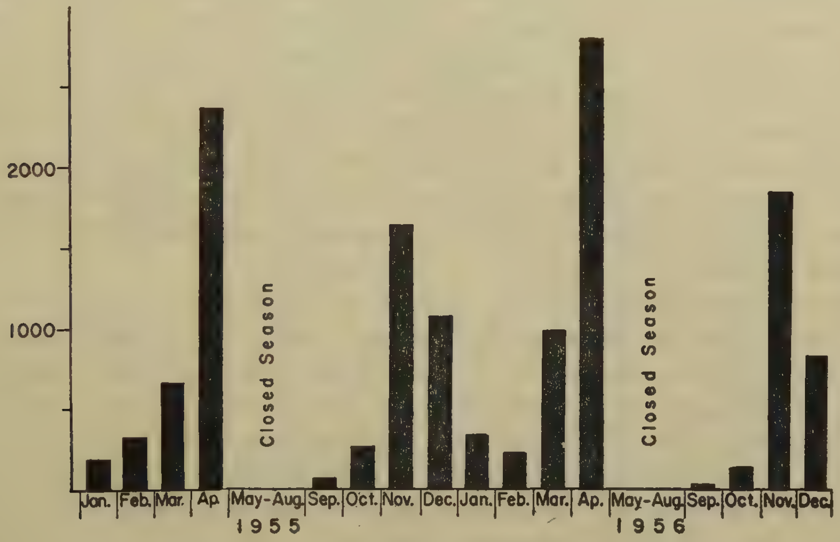

Fig. 5. Monthly landings at the Sirahama Fishery Market. Quantities are shown by their weight in kg. In September and October, the fishing is restricted to only around Oki-no-sima and Nada-no-sima.

mature males migrate to the periphery of the reefs in the breeding season. For *Panulirus interruptus*, LINDBERG (1955) reported the same as recognized by SMITH above cited. On the other hand, OKADA and KATO (1946) reported the migratory power of *Panulirus japonicus* to be relatively small. KINOSHITA (1933) showed their stay in the same fishing ground by tagging experiment.

As has been described and shown in Fig. 5, the commerical landing tends to increase toward spring, but this evidence is more than could be accounted for by spring onshore mass movement. There has been no considerable change in the number of fishermen of Sirahama engaging in the spiny lobster fishery, nor in the number of fishing grounds, excluding two months of September and October when the fishing ground is restricted to only around Oki-no-sima and Nada-no-sima. Changes in the monthly average numbers of the catches per one sheet of the fishing net at various regions in Kanayama Bay (Fig. 3) and in the daily average numbers of the catches per one fisherman at various fishing grounds show the same tendency and no indication of the increasing number of the lobster in shallow water. Furthermore, relatively high yields have been recorded in February and early March, when water temperature is at its lowest. The increasing landing in spring may, therefore, primarily due to the change in activity of the spiny lobster, in relation to increasing temperature and possibly to its breeding behaviour.

Other Members of Palinurids. On the south-west coast of Kii Peninsula, of the genus 6 species *Panulirus japonicus*, *P. longipes*, *P. versicolor*, *P. penicillatus*, *P. homarus* and *P. ornatus* are known to occur (KUBO, 1954). Of these, *Panulirus japonicus* is predominant, and *P. longipes* is often found in the samples of the commerical landing, while the record of the catch of the other four species is very rare. By the examination of the commercial catches at the Sirahama Fishery Market during the fishing season 1955–1956, only three individuals of *Panulirus longipes* were found. Of the allied Palinurid forms, *Scyllarides squamosus* (=*S. sieboldi*), *S. haani* and *Parribacus antarcticus* (=*P. ursus-major*) are common, but less than *Panulirus japonicus*. Of these, the first two Scyllarids are of commercial value as food lobsters.

Some Aspects of Life in Larval Stages

I) PHYLLOSOMA STAGE

A number of the newly hatched phyllosome of *Panulirus japonicus* were collected by the horizontal surface hauling of a large plankton net. It occurs in the plankton from the middle of June to the late of August. Its horizontal distributions in Kanayama Bay and in Tanabe Bay are shown in Table 4 and Fig. 6. In Kanayama Bay, its occurrence in the surface plankton varies irregularly from time to time and from station to station. During daytime on August 1st, 1955, it occurred in large number at Station 102, while there were comparatively few catches from neighbouring Stations 103 and 104. On August 19th, 1955, the catch during daytime from Station 102 was less than that from Station 103. While many were taken at Station 103 during daytime on June 21st, 1956, there were only few taken on later days during the summer of 1956, when the catches from other stations were somewhat high. On August 10th, 1956, hauls were made at just before dawn and during daytime. Many were caught in the former case, but only two were captured in the latter. The catches from Stations 110, 107 and 115 were very few throughout the period investigated. Although the number of the newly hatched phyllosomes in the collections from stations at Kanayama Bay is too small to afford a true picture of the horizontal distribution, and besides there are considerable unevenness and fluctuation in their number, it appears that their occurrence in the plankton in the surface layers is, on the whole, restricted mainly to the vicinities of rocky reefs, where high populations are expected to be present as inferred

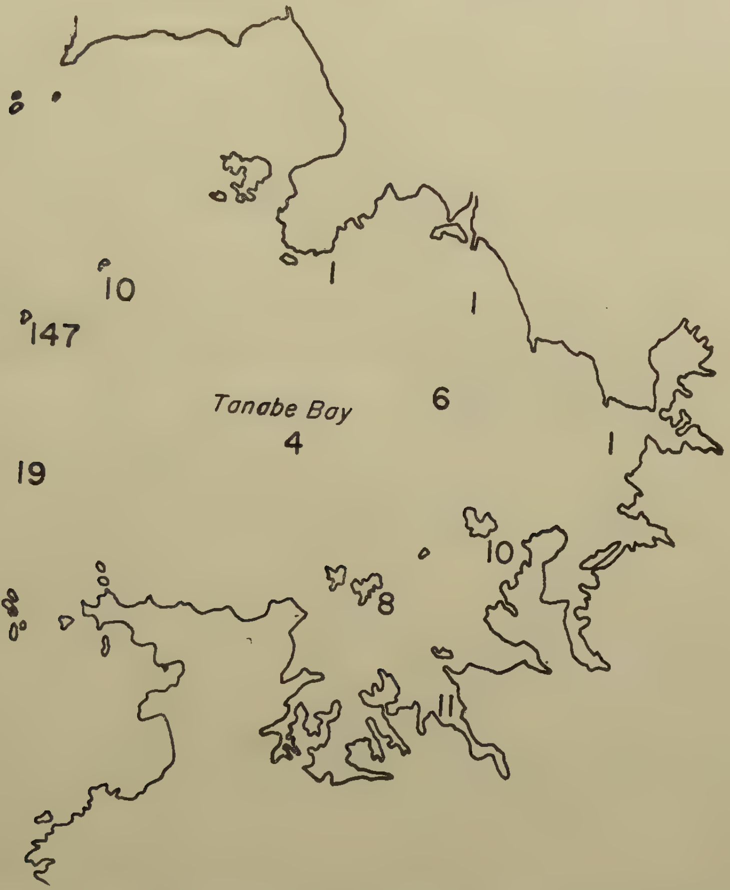

Fig. 6. Horizontal distribution of the newly hatched phyllosomes of *Panulirus japonicus* (VON SIEBOLD) on July 26th, 1956, in Tanabe Bay.

from the data of the commercial landings. Irregularity of their occurrence is possibly due to the uneven occurrence of hatching out.

In Tanabe Bay, the newly hatched phyllosomes occur at various stations in sufficient numbers to bring evidence on their horizontal distribution. During daytime on June 26th, 1956, hauls were made at eleven station and the phyllosomes were found in every sample from these stations (Fig. 6). However, there were marked difference in number between a group of Stations 92, 82, 96, 53, 20, 10 and 14 and a group of Stations 51, 72, 31 and 64. Stations belonging to the former group are all in the vicinities of the rocky reefs and the number of the phyllosomes in the collection from these stations is higher than that from stations of the latter group. Especially, at those stations of innermost part of the bay such as Stations 31 and 51, only one was caught at each. At Station 64, which is situated nearly at the center of the bay and has no rocky reef in its vicinity, four phyllosomes were captured, and this fact indicates that the phyllosomes are brought away by the mechanical action of water movement. On September 3rd, 1956, hauls were made at seven stations (92, 51, 20, 10, 15, and 58), but none were caught.

On June 26th, four stations (81, 02, 03 and 04) were visited to make hauls during daytime. No phyllosome was, however, captured except at Station 81, where only one newly hatched phyllosome was captured.

On July 14th, just before the sunrise, a small plankton net was towed horizontally at four depths (surface, 1–1.5, 2.5–3, and 6–7 m) over about 150 m along the underwater cliff at Station 109. Three newly hatched phyllosomes were taken at the surface (0–0.5 m), but none at other depths. After the sunrise, none were caught at the surface too. Thus, the number of the catch of the phyllosome is too small to obtain an indication of its vertical distribution. However, considering with the fact that many were caught by the horizontal surface hauls of the large plankton net just before the dawn on August 10th at various stations, it seems highly probable that the newly hatched phyllosomes are more abundant at the surface at dawn and diminish after the sunrise.

This smaller number of the catch of the newly hatched phyllosomes by these procedures seems to suggest that their stay in the water as plankton is very short. KINOSHITA (1931) observed the newly hatched phyllosomes in the aquarium and described that they stay at the surface for two days and then descend to the bottom, producing no moult. SHIINO reared the newly hatched phyllosomes for about one month producing no moult (personal communication). If this stage is prolonged in the aquarium, the newly hatched phyllosomes will sink to the bottom before two days will elapse.

It was then hoped to collect the phyllosomes descended to the bottom using the pump. Collections were occasionally made at various situations, such as on the rock surface, among algae, in the rock crevice and rock ledge where the adult lobsters inhabit, but none were found in these samples. If a considerable number of the eggs carried by one female, approximately from 29,000 to 554,000 (INO, 1947), is taken into account, the probable explanation of this fact is that most of the newly hatched phyllosomes are carried away for some distance by the mechanical action of water movement, if their mortality rate is not too high.

II) PUERULUS STAGE

It was hoped to collect the pueruli using the beam trawl and the "Manga" dredge. Station 110 and 107 were mainly visited during daytime and at night, but no puerulus was captured. The results of trawlings of the beam trawl made by Mr. Siro TAKAMATU on September 2nd, 1956, at several stations of innermost part of Tanabe Bay, where *Zostera nana* or *Z. marina* is growing on the bottom, show no catch of the puerulus. On January 23rd, 1956, the "Manga" dredge was used at the muddy deep part and at the innermost muddy part of Tanabe Bay, and no puerulus was taken.

Some fishermen captured pueruli that were attracted to the fish-attracting lamp and were swimming at the surface of water under the lamp. These pueruli were all of *Panulirus japonicus* and the measurements of them are shown in Table 5. These were all caught in the area where rocky reefs lie on the bottom and about 10–20 m in depth. Some fishermen say that the pueruli are attracted only when the fish-attracting lamp is lighted near the rocky reefs in the period between September and October. Other fishermen say that when they trawled at muddy areas of innermost part of Tanabe Bay at night many pueruli have been captured. Other fishermen say that when he was diving in June a number of pueruli were observed among algae. These evidences are also reported by many investigators (KINOSHITA, 1931 ; OHSHIMA, 1941 ; OKADA and KUBO, 1950). It may probably be said that the pueruli are living normally in the rocky area as in the adult.

Some descriptions on the attraction of pueruli by the light will be mentioned under the article of "Effect of the Fish-attracting Lamp on the Larvae."

III) YOUNG LOBSTER

One young lobster of *Panulirus japonicus* was captured in a small hole on the rock at 2 m in depth near Station 109 on July 24th, 1956. The hole was as large as its body, so that the animal was in a situation with its 2nd antennae completely exposed outside of the hole.

While diving, three young lobsters (sub-adult) were observed, each inhabiting in one small hole on the rock and in the same situation mentioned above. These animals are a little larger than that mentioned above ; one on September 4th, 1956, at 5 m in depth near Station 109 by me, two on December 15th, 1956, at 2–3 m in depth at northern shore of the Laboratory by Mr. Ryônosuke OKUNO. Measurements of one of those are shown in Table 5. In the latter case, they were also observed on the following day. It is thus undoubted that the young lobsters are inhabiting in small holes on the rock.

Comparing the measurements of the first and the last shown in Table 5, some differences are noticed. These increments are presumably due to the growth in the period between they were found.

Effect of the Fish-attracting Lamp on the Larvae

Many fishermen of Sirahama emphasize that the fish-attracting lamp of "Bôuke-ami" fishery affects on the larvae of the spiny lobster with its intensity of light and leads them to come to the surface, swimming restlessly around far enough to die. They indicate, also, that it occurs from July to October, the majority being seen in September. But this evidence has not been perceived by most of fishermen of Tanabe, Minabe or Sakai. Here arise some questions whether the larvae of the spiny lobster, so fishermen report, are true larvae of *Panulirus japonicus* or not, and whether they are seen frequently in great number or not.

It was, therefore, asked in 1955 for fishermen of Sirahama engaging in the "Bôuke-ami" fishery to record the occurrence of the larvae with the date, locality, depth, and condition of the sea when they were found, and to collect the larvae attracted. But, unfortunately, only a few records and collections were available. Only one puerulus of *Panulirus japonicus* was attracted and captured near Tonda on September 22nd by Mr. Chiyozi KANAYA. Other fishermen made collections of the larvae of the spiny lobster, as they call so, but these were in fact all the Alima larvae of stomatopods, excluding one which is alike the puerulus but species is undeterminable. In 1956, fisherman of Sirahama state that they have never seen the larvae, though they fished for about a month and a half from the middle of May to the end of June in Kanayama Bay.

In 1956, Mr. Hidematsu TOYAMA at Minabe captured fifteen larvae during the period from the beginning of September to the end of October. Unfortunately, five specimens collected on September 30th were lost away. These were all pueruli of *Panulirus japonicus* (Table 5). He reported that when fished off the coast where depth is over 40 m, many large long-spined transparent larvae were taken. But when fished in the vicinities of the rocky reefs ranging from 10 to 15 m in depth, many transparent larvae with long slender antennae and without long spines were captured. The formers in his information are the Alima larvae and the latters are the pueruli.

It is not certain from these observations made by the commercial fishermen whether the phyllosomes are attracted to the fish-attracting lamp or not. To test this, the fish-attracting lamp was lighted at some stations and the organisms attracted to the lamp were collected using the plankton net. The observation was carried out in two manners. One was designed to make a comparison between the station close to rocky reefs and the station somewhat off the rocky reefs. Three stations were chosen in Kanayama Bay, namely Stations 107, 109 and 111. These stations were visited in the same night, making tows from 1 m depth to the surface under the lamp before and 20 minutes after it was lighted. But no phyllosome was caught at all.

Another observation was attempted to know the change in number of the lamp-attracted phyllosomes during night. Vertical tows were made under the lamp at intervals of two or three hours. One newly hatched phyllosome was taken at midnight on July 21st, 1956, at Station 10, and this is the only one case that the newly hatched phyllosome was captured under the lamp. It can hardly be said that the newly hatched phyllosomes are attracted to the lamp.

Thus, it may be concluded that the pueruli of *Panulirus japonicus* are attracted to the lamp when it is lighted in the vicinities of the rocky areas, but this is not the case of its newly hatched phyllosomes.

Discussion

Many investigators have written as to the occurrence of the phyllosomes of various spiny lobsters. CUNNINGHAM (1892) described as follow: "These larvae (the phyllosomes of *Palinurus vulgaris*) do not occur near shore, for we have never taken them before in our ordinary tow-nets worked within a mile or two of the coast. On two occasions on which I obtained the larvae, I captured them only when towing the net at the surface, not when it was sunk to some depth." But RUSSELL (1927), comparing his results on the vertical distribution of marine macroplankton with that of CUNNINGHAM, says: "These results are opposed to mine, but it may be that the catches were made much nearer the Eddystone, where up-welling currents might upset the normal distribution of the plankton in more quiet water." According to his conclusions of three papers (1925, 1927, 1928), the phyllosomes of *Palinurus vulgaris* appear to have been very near the bottom during the daylight; at dusk they are distributed rather evenly in all layers and great in number; at midnight and dawn the numbers are somewhat reduced. On the other hand, ANDERTON (1907) observed the vast number of the first embryo⁽¹⁾ of *Palinurus edwardsii* swarmed in the large tank, swimming freely near the surface. GILCHRIST, in his two papers (1913, 1916) on the larval stages of *Jasus lalandii*, says that on hatching the naupliosoma rapidly ascends to the surface; in a few hours (4–6) the phyllosoma stage is assumed; later, the phyllosomes avoid the light and seem to descend from the upper layers of the water on ecdysis. Moreover, he took a series of two-nettings at more or less regular intervals in Table Bay from January, 1913, to May, 1914, and found the first phyllosomes in abundance in the inshore waters during the summer months, and much smaller number of more advanced stages in the deep waters.

NAKAZAWA (1917) consented with this description of GILCHRIST, but he made an assumption that the newly hatched phyllosomes may stay near the bottom when they released in quiet waters and not move upward to the surface by themselves, and their occurrence at the surface may be merely due to upwelling movement of water. Later, KINOSHITA (1931) made the observations on the newly hatched phyllosomes of *Panulirus japonicus* reared in the aquarium and reported that the phyllosomes descend to the bottom after 2 days duration of the surface life, producing no moult. Thus, although RUSSELL and NAKAZAWA opposed to the opinion that the phyllosomes swim upward to the surface, it seems probable that the newly hatched phyllosomes pass a

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1) THOMSON (1907) described that this has the characteristic *Phyllosoma* appearance, and later GILCHRIST (1913) named this larvae as *naupliosoma*. The species name of *Palinurus edwardsii* was corrected as *Jasus lalandii* by ARCHEY (1914) and GILCHRIST (1916).

surface planktonic life, though it is for a short period of time. In the present investigations, a number of the newly hatched phyllosomes of *Panulirus japonicus* were taken at the surface in the vicinities of rocky reefs even during the daytime.

Considerable variations are seen in the number of the newly hatched phyllosomes of *Panulirus japonicus*, that occur in the surface plankton, from time to time and among stations. This variations or fluctuations seem to be closely related to the unevenness of occurrence of the hatching. KINOSHITA (1931) suggested that the hatching occurs at night or dawn. The vast number of eggs carried by one female, on hatching, may possibly result in producing great number of the newly hatched phyllosomes in the surface layers when they are released. The shortness of their duration in the surface layers caused their distribution being restricted in the vicinity of the place where they are released from their mother, thus preventing the even distribution throughout the area.

In their stay in the surface layers, though for a short period of time, the newly hatched phyllosomes may disperse wider from where they are released. This dispersal is probably due to the mechanical action of water movement, because their swimming power seems to be too small to migrate over such a distance as will be mentioned below within a short period of time, for some are captured at the centre of Tanabe Bay, where no rocky reef is expected within 2 km. However, none were caught far off the coast (Stations 02, 03, 04), though there is one at Station 81 which is situated over the underwater reef. Thus, this dispersal in the newly hatched phyllosoma stage may ordinarily not extend far over several miles.

It is not certain whether the majority of the newly hatched phyllosomes disperse and reach the bottom far from where they are hatched out or settle down to the bottom in the vicinities of the places where they are released from their mothers.

LINDBERG (1955) described on large and intermediate-sized phyllosomes of *Panulirus interruptus* taken during the mid-water trawling operations and says: "It is perhaps significant, however, that phyllosomes are taken at greater frequency during these operations than when surface samples alone are made. The presence of these advanced larval stages at these suggested depths in the month of March leads us to think that the larvae spend a minimum of six to nine months in the plankton. This fragmentary evidence suggests that the settling of larval forms may occur in deep water and that the metamorphosed bottom stages then migrate to shallow water." It is, however, not certain if these assumptions are applicable to the larval life of *Panulirus japonicus*, for I have no evidence to support it.

Summary

1. The present paper deals with the results of the investigations on the larval and adult Japanese spiny lobster, *Panulirus japonicus*, carried out between July, 1955, and January, 1957, in the neighbouring waters of the Seto Marine Biological Laboratory, Wakayama Prefecture.

2. The samples of the catch of the adult spiny lobster were examined and their population composition was analysed in terms of carapace length and sex ratio. They are more abundant in the fishing grounds facing the open sea. The monthly commercial landings, the monthly catches per unit effort and the daily catches per one fisherman increase toward the warmer months of spring, probably due to the increasing activity of the species concerned. There is an apparent progression of the mode of carapace length by month, but age groups are not discernible.

3. The newly hatched phyllosomes of *Panulirus japonicus* occur from the middle of June to the end of August, generally in accordance with the period of spawning season of this species. They are found in abundance in the surface layer in the vicinities of the rocky reefs, but their numbers vary irregularly.

4. No phyllosome in advanced stage was captured in the surface layer. These evidences suggest that the newly hatched phyllosomes may spend a short planktonic life in the surface layer. The pueruli of *Panulirus japonicus* are mostly captured in the shallow waters of rocky areas. It is not certain whether the newly hatched phyllosomes that ascend to the surface are brought away far off the coast or not.

5. From the horizontal surface towings, it seems highly probable that the newly hatched phyllosomes are most abundant at the surface at dawn and diminish after the sunrise.

6. The larvae of *Panulirus japonicus* in the puerulus stage only are attracted to the fish-attracting lamp when it is lighted close to the rocky reefs.

REFERENCES

ANDERTON, J. 1907. Observations on New Zealand fishes. Trans. N. Z. Inst., Vol. 34, pp. 477–496.

BRADSTOCK, C. A. 1950. A study of the marine spiny crayfish *Jasus lalandii* (Milne-Edwards) including accounts of autotomy and autospasy. Zool. Publ. Victoria Univ. College, Vol. 1, no. 7, pp. 1–38.

CUNNINGHAM, J. T. 1892. On the development of *Palinurus vulgaris*, the rock lobster or sea crayfish. Journ. Mar. Biol. Assoc., N. S., Vol. 2, no. 2, pp. 141–150.

DAWSON, C. E. and IDYLL, C. P. 1951. Investigations on the Florida spiny lobster *Panulirus argus* (Latreille). State of Florida, Board of Conservation, Technical Series, No. 2, pp. 6–39.

GILCHRIST, J. D. F. 1913. A free swimming nauplioid stage in *Palinurus*. Journ. Linn. Soc., Zool., Vol. 32, no. 216, pp. 225–231.

——— 1916. Larval and post-larval stages of *Jasus lalandii*. Ibid., Vol. 33, pp. 101–125.

GORDON, I. 1953. On the puerulus stage of some spiny lobsters (Palinuridae). Bull. British Museum (Nat. Hist.), Zool., Vol. 2, no. 2, pp. 17–42.

GURNEY, R. 1936. Larvae of Decapod Crustacea. Part III. Phyllosoma. Discovery Reports, Vol. 12, pp. 400–440.

INO, T. 1947. Number of eggs and spawning-periods of Ise-Ebi (*Panulirus japonicus* de Haan). Bull. Jap. Soc. Sci. Fish., Vol. 13, no. 1, pp. 32–33. (in Japanese)

——— 1950. Observation of the spawning cycle of Ise-ebi, (*Panulirus japonicus* (v. Siebold)). Ibid., Vol. 15, no. 11, pp. 725–727. (in Japanese)

KINOSHITA, T. 1931. Some ecological notes on *Panulirus japonicus*. Suisankenkyûsi (Journ. Fish. Res.), Vol. 26, no. 7, pp. 231–236. (in Japanese)

——— 1934. On Puerulus and further metamorphosis of *Panulirus japonicus*. Zool. Mag., Tokyo, Vol. 46, no. 551, pp. 391–399. (in Japanese)

KUBO, I. 1950. On two forms of Puerulus found in Japanese waters with special reference to that of *Panulirus versicola* (Latr.). Bull. Jap. Soc. Sci. Fish., Vol. 16, no. 3, pp. 91–98. (in Japanese)

——— 1954. Systematic studies on the Japanese macrurous decapod Crustacea. 3. On the Palinurid lobsters. Journ. Tokyo Univ. Fish., Vol. 41, no. 1, pp. 95–105.

KUBO, I. and HATTORI, S. 1947. An analysis of tagging result of *Panulirus japonicus* (v. Siebold), with special reference to rate of growth and ecdysis. Bull. Jap. Soc. Sci. Fish., Vol. 13, no. 2, pp. 108–110. (in Japanese)

LINDBERG, R. G. 1955. Growth, population dynamics, and field behavior in the spiny lobster, *Panulirus interruptus* (Randall). Univ. Calif. Pub. Zool., Vol. 59, no. 6, pp. 157–248.

NAKAMURA, S. 1940. Ecological studies on the spiny lobster, *Panulirus japonicus* (v. Siebold), with special reference to its conservation, I. Journ. Imp. Fish. Inst., Vol. 34, no. 1, pp. 101–113.

NAKAZAWA, K. 1917. Studies on the metamorphosis of *Panulirus japonicus*, with notes on the ecology of its larvae. Zool. Mag., Tokyo, Vol. 29, no. 347, pp. 259–267. (in Japanese)

OHSHIMA, Y. 1935. On the habitat of *Panulirus japonicus*. Yôsyokukaisi (Journ. Jap. Soc. Aquicult.), Vol. 5, nos. 5 & 6, pp. 75–83. (in Japanese)

——— 1941. Some ecological aspects on *Panulirus japonicus*. Suisangakukaihô, Vol. 8, nos. 3 & 4, pp. 231–238. (in Japanese)

——— 1942. On the phyllosomes of the genus *Panulirus*. Ibid., Vol. 9, no. 1, pp. 36–44. (in Japanese)

——— 1948. A consideration on the period of metamorphosis and the age in spiny-lobster, *Panulirus japonicus* v. Siebold. Bull. Jap. Soc. Sci. Fish., Vol. 13, no. 5, pp. 210–212.

OKADA, Y. and KATO, K. 1946. Studies on the Japanese spiny lobster, *Panulirus japonicus* (v. Siebold). I. On the migration of *P. japonicus*. Short Reports from Res. Inst. Nat. Res., No. 1, pp. 1–10. (in Japanese)

OKADA, Y. and KUBO, I. 1946. Studies on the Japanese spiny lobster, *Panulirus* (v. Siebold. II. Sex ratio, biological minimum and body length and body weight composition. Ibid., No. 4, pp. 1–9. (in Japanese)

——— & ——— 1948. Studies on the Japanese spiny lobster, *Panulirus japonicus* (v. Siebold). V. Puerulus and young. 1. Miscel. Rept. Res. Inst. Nat. Res., No. 12, pp. 20–24. (in Japanese)

——— & ——— 1950. Studies on the Japanese spiny lobster, *Panulirus japonicus* (v. Siebold). VI. Comparison of puerulus, young and adult. Ibid., No. 15, pp. 41–46. (in Japanese)

OKADA, Y., KUBO, I. and TAKAGI, K. 1947. Studies on the Japanese spiny lobster, *Panulirus japonicus* (v. Siebold). III. Spawning-periods. Zool. Mag., Tokyo, Vol. 57, no. 3, pp. 27–28. (in Japanese)

RUSSELL, F. S. 1925. The vertical distribution of marine macroplankton. An observation on diurnal changes. Journ. Mar. Biol. Assoc., N. S., Vol. 13, no. 4, pp. 769–809.

——— 1927. The vertical distribution of marine macroplankton. V. The distribution of animals caught in the ring-trawl in the daytime in the Plymouth area. Ibid., N. S., Vol. 14, no. 3, pp. 557–608.

——— 1928. The vertical distribution of marine macroplankton. VI. Further observations on diurnal changes. Ibid., N. S., Vol. 15, no. 1, pp. 81–99.

SHIINO, S. M. 1950. Studies on the embryonic development of *Panulirus japonicus* (von Siebold). Journ. Fac. Fish. Pref. Univ. Mie, Vol. 1, no. 1, pp. 1–168. (in Japanese)

SMITH, F. G. W. 1948. The spiny lobster industry of the Caribbean and Florida. Carib. Res. Coun., Fish. Ser., No. 3, pp. 1–49.

SUTCLIFFE, W. H. JR. 1952. Some observation on the breeding and migration of the Bermuda spiny lobster, *Panulirus argus*. Proc. Gulf Carib. Fish. Inst., Fourth Annual Session, pp. 64–69.

——— 1953. Further observations on the breeding and migration of the Bermuda spiny lobster, *Panulirus argus*. Journ. Mar. Res., Vol. 12, pp. 173–183.

TERAO, A. 1929. On the embryonic development of the spiny lobster, *Panulirus japonicus* (v. Siebold). Jap. Journ. Zool., Vol. 2, no. 4, pp. 387–449.

THOMSON, G. M. 1907. Note on the development of *Palinurus edwardsi*. Trans. N. Z. Inst., Vol. 34, p. 484.

APPENDIX

Table 1. List of stations chosen for this study in Kanayama Bay, Tanabe Bay and off Bansyo-no-hana. (Also see Fig. 1)

St. No.	Substratum	Depth (m)	Remarks
1) Kanayama Bay			
102	rock	5–7	close to the rocky reef of Sisô-zima
103	rock	8–10	close to the rocky reef of Sisô-zima
104	rock	9–11	near the rocky reef of Sisô-zima
107	boulders	4–6	close to the rocky reef of Seto
109	boulders	6–8	close to the rocky reef of Taka-sima
110	sand	4–5	at the bottom of the arched sandy shore
111	rock	3–8	over the underwater reef
114	sand	20	over the deep
115	sand	8–10	near the rocky reef
2) Tanabe Bay			
10	mud	9–12	near the rocky reef of Hatake-zima
14	mud	2–4	close to the rocky reef of the mouth of Hosono
15	*Zostera marina*	2–3	innermost part of Hosono
20	mud	8–10	near the rocky reef of Ka-sima
31	mud	8	
51	sand	4–5	near the sandy shore
53	rock	2–6	over the underwater reef
58	rock	10–15	near the rocky reef of Ezura
60	sand	6–7	
64	mud	23–25	over the deep
72	rock	9–12	near the rocky reef
82	sand	31–34	
92	rock	11–20	close to the rocky reef of Oki-no-sima
96	rock	4–12	close to the rocky reef of Nada-no-sima
101	boulders	4–9	near the rocky reef of Tô-sima
3) Off Bansyo-no-hana			
81	rock	16–18	1 mile off, over the underwater reef of Seto-ga-se
01	mud	60	1.5 mile off
02	mud	80	3 miles off
03	mud	100	6 miles off

Table 2. Daily average numbers of the catches per one fisherman at various fishing grounds.

Date	Date of lunar month	Condition of the sea	Fishing grounds		
			Kanayama Bay	Southern coast of Seto-zaki	Sisô-zima
Jan. 13	0	very smooth	2.0	4.8	2.0
15	2.0	smooth	—	10.3	1.3
16	3.0	slight	2.5	3.3	4.0
17	4.0	smooth	2.5	3.6	1.3
18	5.0	very smooth	2.2	2.1	—
19	6.0	moderate swell	—	—	5.0
Feb. 15	3.2	very smooth	3.6	2.8	—
Mar. 8	25.2	slight	9.0	—	—
9	26.2	slight	5.8	6.0	—
22	9.5	smooth	1.5	—	2.0
Apr. 4	22.5	slight swell	4.7	20.0	—
5	23.5	very smooth	4.0	6.8	—
6	24.5	very smooth	4.2	9.1	—
7	25.5	very smooth	4.5	9.3	—
8	26.5	slight swell	5.0	8.5	1.0
11	0	moderate swell	8.0	—	—
12	1.0	moderate swell	9.8	10.5	4.0
14	3.0	rather rough swell	8.5	9.9	—
15	4.0	smooth	6.7	—	—
16	5.0	slight swell	7.3	8.0	—
17	6.0	very smooth	2.5	—	4.0
18	7.0	very smooth	3.5	5.6	—

Table 3. Daily average numbers of the catches per unit effort (per one sheet of net) at various regions in Kanayama Bay in the years 1955–1956. (see Fig. 3)

Date	Date of lunar month	Conditions of the sea	Regions		
			T	G	C
Nov. 18	3.6	smooth	—	0.21	—
19	4.6	smooth	0.43	—	
20	5.6	smooth	0.43	0.43	0.29
21	6.6	smooth	0.24	—	
Dec. 3	18.6	smooth	0.18	—	
5	20.6	smooth	0.43	—	
6	21.6	smooth	0.28	—	—
7	22.6	moderate swell	—	0.14	0.79
8	23.6	smooth	0.30	0.22	—
9	24.6	moderate swell	—	—	1.00
10	25.6	smooth	—	0.08	0.21
11	25.6	smooth	0.08	0.71	0.19
13	28.6	smooth	—	—	0.03
14	29.6	slight swell	—	0.87	0.37
15	0.8	smooth	—	0.21	—
16	1.8	moderate swell	0.68	—	—
17	2.8	rather rough swell	—	0.25	—
18	3.8	slight swell	—	—	1.27
19	4.8	smooth	—	0.20	—
20	5.8	smooth	0.00	—	—
22	7.8	slight swell	—	0.71	0.62
Feb. 2	20.0	smooth	0.28	—	—
3	21.0	smooth	—	0.20	0.10
6	24.0	smooth	0.57	0.43	
9	27.0	moderate swell	—	0.50	
11	29.0	slight swell	—	0.60	—
14	2.2	smooth	—	0.21	0.08
15	3.2	very smooth	—	0.08	0.23
Mar. 2	19.2	smooth	—	0.21	0.15
3	20.2	very smooth	—	0.21	0.20
5	22.2	very smooth	—	0.28	0.00
6	23.2	smooth	0.50	—	—
9	26.2	slight swell	0.71	—	—
10	27.2	slight swell	—	0.47	—
11	28.2	very smooth	—	0.00	—
16	3.5	moderate swell	0.33	—	—
18	5.5	slight swell	—	—	1.10
19	6.5	slight swell	0.70	—	—
21	8.5	smooth	—	0.38	0.42
Apr. 1	19.5	smooth	0.64	—	—
3	21.5	smooth	0.95	—	—
5	23.5	very smooth	0.59	—	—
7	25.5	very smooth	0.54	—	—
8	26.5	slight swell	0.53	—	—

Table 4. Numbers of the newly hatched phyllosomes of *Panulirus japonicus* (VON SIEBOLD) caught in the surface layer at various stations in Kanayama Bay in the period between August, 1955, and January, 1957. Numbers in a volume of 78 m^3 of water.

Date	103	107	109	110	111	114	115	101	102	104
1955										
Aug. 1 (dt)	2	—	—	—	—	—	—	—	14.5	1.6
Aug. 19 (dt)	6	—	—	—	—	—	—	—	2	—
Sept. 2 (dt)	—	0	0	—	—	—	—	—	—	0
Sept. 4 (n)	—	0	0	—	—	—	—	—	—	—
Oct. 5 (dt)	—	0	0	—	—					
Oct. 22 (dt)	—	0	0	—	—	—	—	—	—	0
Oct. 22 (n)	—	0	0						—	—
Nov. 29 (dt)	—	0	0	—	0	—	—	—	—	—
Dec. 2 (n)	—	0	0	—	0	—		—		—

Table 4. (continued)

Date	103	107	109	110	111	114	115	101	102	104
1956										
Jan. 17 (dt)	—	0	0	—	0	—	—	—	—	—
Jan. 17 (n)	—	0	0	—	0	—	—	—	—	
Feb. 15 (dt)	—	0	0	—	0	—	—	—	—	—
Mar. 10 (dt)	—	0	0	—	0	—	—	—	—	0
Mar. 10 (n)	—	0	0	—	0	—	—	—	—	—
Apr. 13 (dt)	—	0	0	—	0	—	—		—	
May 12 (dt)	0	0	0	0	0	0	0	—	—	—
May 24 (dt)	—	—	—	—	—	—	—	0	0	—
May 25 (dt)	0	0	0	0	0	0	0	—	—	—
May 28 (n)	0	0	0	0	0	0	0	0	—	—
June 6 (dt)	0	0	0	0	0	0	0	0	—	—
June 15 (n)	0	0	0	0	0	0	0	0	—	—
June 21 (dt)	16	0	0	0	3	3	1	2	—	—
June 28 (dt)	0	1	0	0	1	0	0	0	—	—
July 9 (dt)	1	0	0	0	0	0	0	0	—	—
July 22 (dt)	0	0	0	1	0	0	—	5	—	—
Aug. 10 (dw)	0	0	3	0	2	4	0	1	—	—
Aug. 10 (dt)	1	0	0	0	0	0	0	0	—	—
Aug. 19 (dt)	—	0	0	—	0		—	—	—	
Sept. 1 (dt)	0	0	0	0	0	0	0	0	—	—
Oct. 2 (dw)	0	0	0	0	0	0	0	0	—	—
Oct. 2 (dt)	0	0	0	0	0	0	0	0	—	—
Oct. 30 (dt)	0	0	0	0	0	0	0	—	—	—
Nov. 18 (dt)	0	0	0	0	0	0	0	0	—	—
Dec. 16 (dt)	0	0	0	0	0	0	—	0	—	—
1957										
Jan. 23 (dt)	0	—	0	—	—	—	—	—	—	—

dt: daytime, n: night, dw: dawn.

Table 5. Measurements of specimens of the pueruli, the young and the sub-adult lobsters of *Panulirus japonicus* (VON SIEBOLD).

Date	Locality	Depth (m)	Method	Measurements* (mm)				
				bl	cl	bw	bh	al
I) Puerulus								
Sept. 22, 1955	off Tonda	—	light	20.2	7.0	5.0	3.8	17.2
Sept. 1, 1956	off Senri, Minabe	10	light	20.8	7.2	5.0	4.0	21.5
〃 〃 〃	〃	〃	〃	27.0	9.8	6.7	4.8	31.5
Sept. 30, 1956	off Nakayama, Iwasiro	20	light	20.5	7.1	5.7	4.1	16.2
〃 〃 〃	〃	〃	〃	20.8	7.3	5.2	4.0	23.0
〃 〃 〃	〃	〃	〃	20.9	7.2	5.2	3.4	22.0
〃 〃 〃	〃	〃	〃	21.0	7.3	5.2	3.8	22.2
〃 〃 〃	〃	〃	〃	24.6	8.1	6.9	5.6	20.6
Oct. 3, 1956	off Nakayama, Iwasiro	20	light	26.5	9.9	6.8	4.8	28.5
Oct. 4, 1956	off Nakayama, Iwasiro	20	light	26.8	9.8	6.8	5.0	27.6
II) Young (Sub-adult)								
July 24, 1956	near Taka-sima	4	diving	26.2	8.5	6.8	6.1	42.4
Dec. 12, 1956	northern shore of the Laboratory	2	diving	70.0	20.8	17.0	15.8	141.2

* bl: body length, cl: carapace length, bw: body weight,
bh: body height, al: 2nd antennal length.

EXPLANATION OF PLATES VI-VII

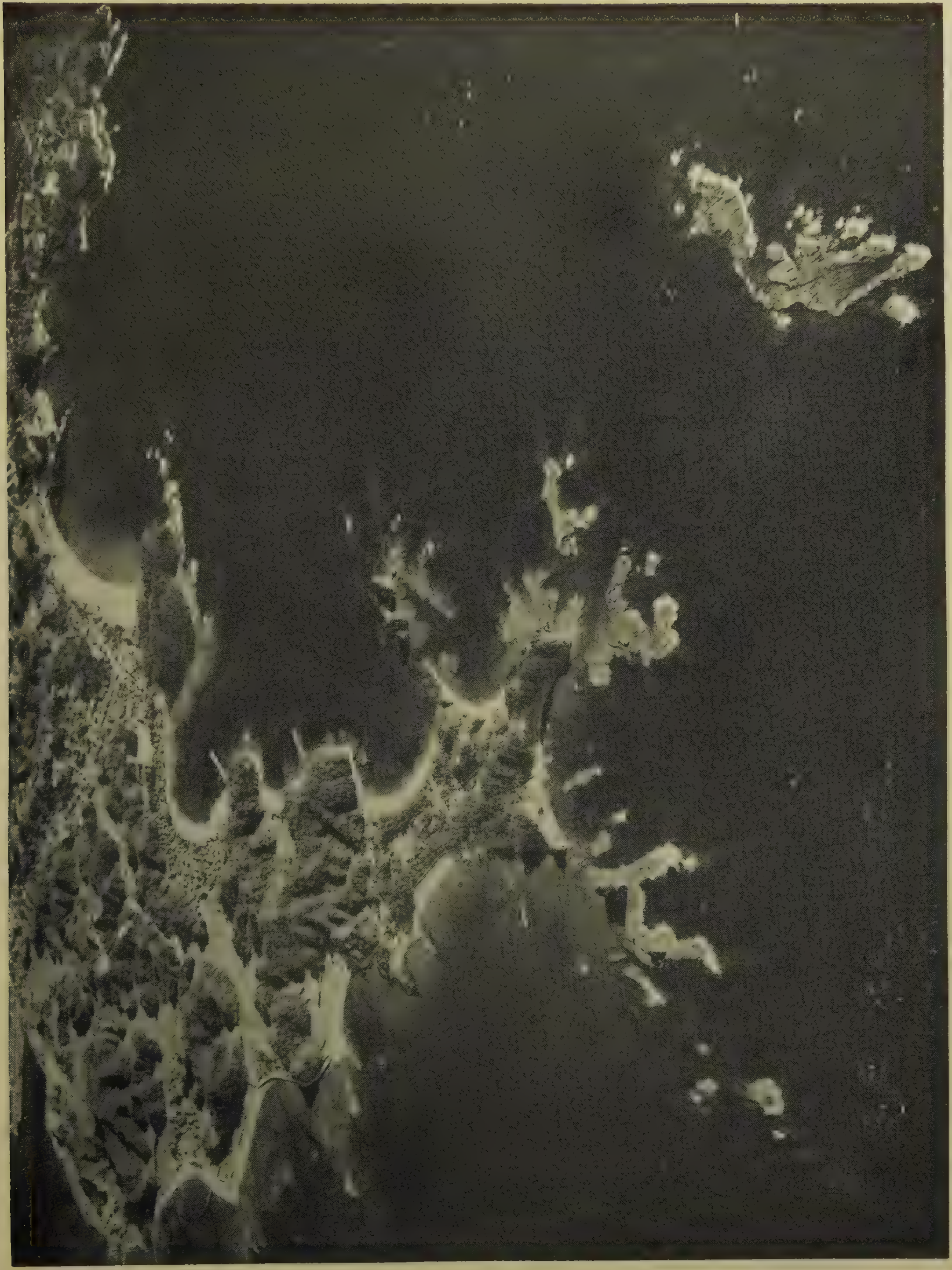
PLATE VI

Fig. 1. Aerial view of Bansyo-no-hana and Kanayama Bay looking southeastward. Underwater reefs are clearly seen. Photo by Osaka Yomiuri Shinbun, Nov. 1956.

PLATE VII

Fig. 1. Two lobsters sheltered in small holes on the roof of a large rock cave. Photo under water by E. HARADA, Nov. 1956.

Fig. 2. A lobster sheltered in a ledge at the bottom of a large rock cave. Photo under water by E. HARADA, Nov. 1956.



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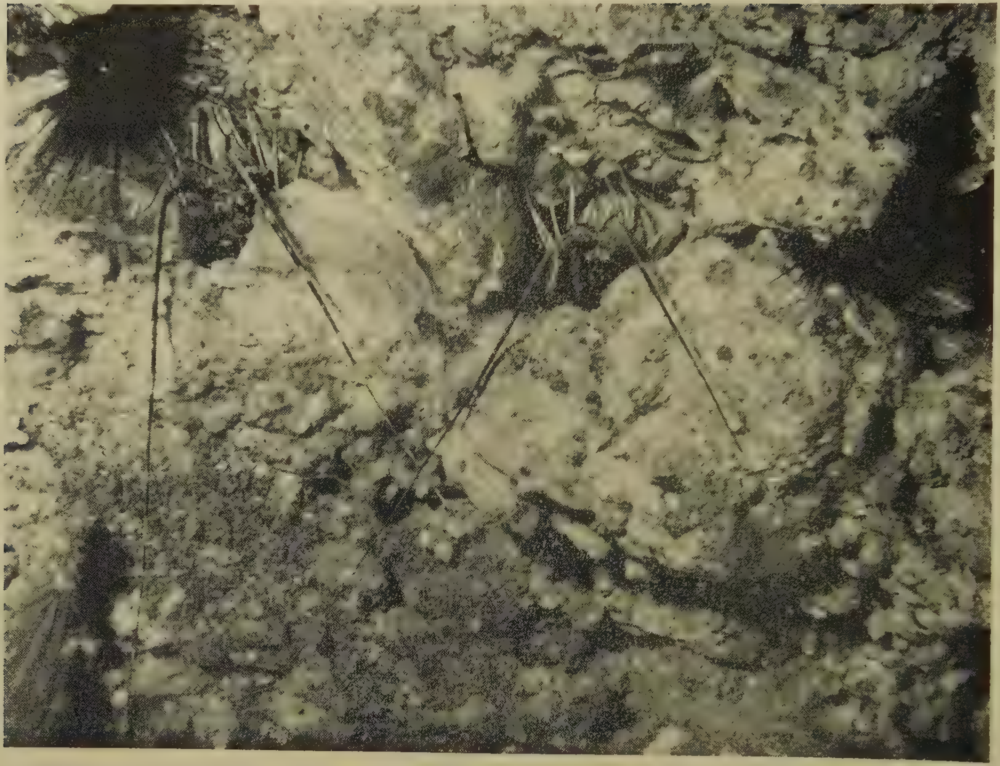

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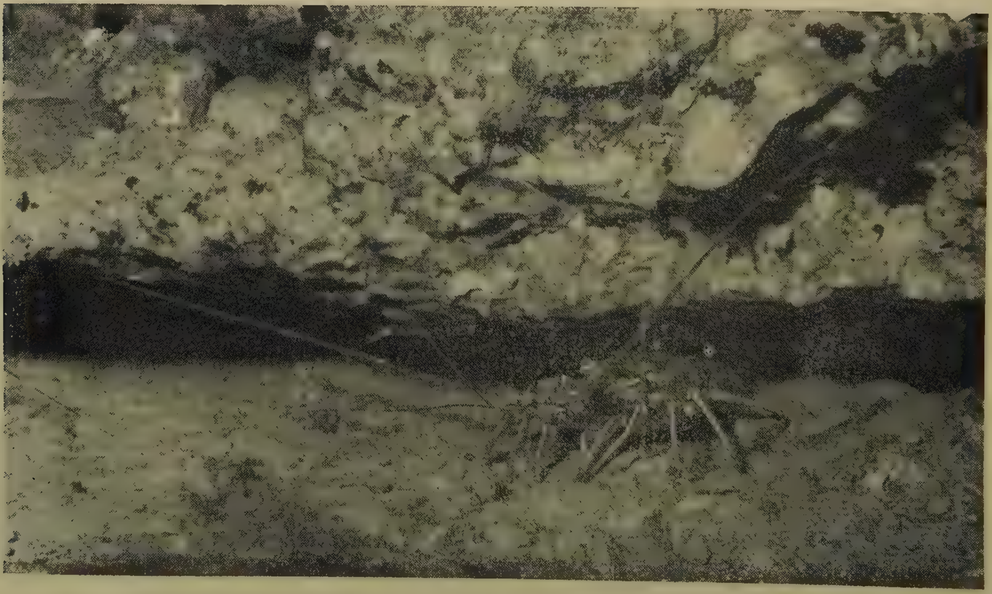

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RECORD OF WORKS

DONE AT THE SETO MARINE BIOLOGICAL LABORATORY

1955（昭和30年）

Contribution
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HABE, Tadashige〔波部忠重〕: 函館港の貝類遺骸〔Shell remains in Hakodate Harbour〕. 新生代の研究〔*Sinseidai no Kenkyu*〕, No. 21, pp. 11–12. ... (Jap. **85**)

———— : ボタンマツワリダカラ（新称）について〔Notes on *Pedicularia* (*Pedicularíona*) *stylasteris* Hedley var.〕. 貝類雑〔*Venus*: *Jap. J. Malac.*〕, 18 (3), pp. 159–160. (With English rés.) .... (Jap. **89**)

———— : カワアイとフトヘナタリの産卵〔Spawning of *Cerithidea djadjariensis* and *C. rhizophorarum*〕. *Ibid.*, 18 (3), pp. 204–205. .... (Jap. **90**〕

———— : アラレタマキビの産卵〔The breeding of *Nodilittorina granularis* (Gray)〕. *Ibid.*, 18 (3), pp. 206–207. (With English rés.) .... (Jap. **91**)

———— : ヴラウズカニモリ属の分類学上の位置〔Notes on the systematic position of the genus *Orectospira* Dall 1925〕. 動物雑〔*Zool. Mag.*〕, 64 (8), pp. 259–260. (With English rés.) .... (Jap. **98**)

———— : 二枚貝ヌマコダキガイについて〔Notes on *Potamocorbula* (gen. nov. *amurensis* (Schrenck)〕. *Ibid.*, 64 (9), pp. 271–272. (With English rés.). (Jap. **99**)

———— : v. Bertin の記載したサラガイ類3種について〔Notes on three Tellinid species described by v. Bertin〕. 貝類雑〔*Venus*: *Jap. J. Malac.*〕, 18 (4), pp. 240–243. (With English rés.) .... (Jap. **102**)

———— : 岩手県大船渡湾の貝類遺骸の堆積〔Deposit of shell remains in Ofunato Bay, Iwate Pref., northern Japan〕. *Ibid.*, 18 (4), pp. 244–251. (With English rés.) .... (Jap. **103**)

———— : Fauna of Akkeshi Bay, XXI. Pelecypoda and Scaphopoda. *Publ. Akkeshi Mar. Biol. Stat.*, No. 4, pp. 1–31, pls. 1–7. .... **250**

———— : A list of the Cephalaspid Opisthobranchia of Japan. *Bull. Biogeoger. Soc. Japan*, 16–19, pp. 54–79, pl. 4. .... **264**

———— & ITOIGAWA, Jyunji〔糸魚川淳二〕: (1954). 燧灘の貝類遺骸の堆積〔Deposit of shell remains in Hiuchi-nada〕. 日本地質学会関西支部会報〔*Bull. Kansai Branch Geol. Soc. Japan*〕, No. 25, pp. 1–2.

———— & ———— : 紀伊水道の貝類遺骸の堆積〔Deposit of shell remains in Kii Strait〕. *Ibid.*, No. 27, pp. 3–5.

———— & YAMAZI, I.〔山路勇〕: 宮津湾の生物海洋学的特徴〔Bio-oceanographical characteristics of the Miyazu-wan〕. 日本生物地理学会会報〔*Bull. Biogeogr. Soc. Japan*〕, 16–19, pp. 399–406. .... (Jap. **97**)

Harada, Eiji & Kawanabe, Hiroya〔原田英司・川那部浩哉〕：コメツキガニの行動と相互作用〔The behavior of the sand-crab, *Scopimera globosa* de Haan, with special reference to the problem of coaction between individuals〕. 日生態会誌〔*Jap. J. Ecol.*〕, 4 (4), pp. 162–165. (With English rés.) .... (Jap. **88**)

Ishibashi, Masayoshi & Hara, Tadashi : On the content of rubidium and cesium in sea-water. *Rec. Oceanogr. Wks. Japan*, N. S., 2 (1), pp. 45–48.

Kawai, David Kiyozo : Carbonic anhydrase in pearl oyster, II. Changes of the enzyme activity in relation to growth and seasons. *Publ. Seto Mar. Biol. Lab.*, 5 (1), pp. 89–94.

Kubo, Itsuo〔久保伊津男〕：本邦産 *Leptochela* 属エビ類およびその分布について〔On Leptochelan shrimps in Japan〕. 日本生物地理学会会報〔*Bull. Biogeogr. Soc. Japan*〕, 16–19, pp. 98–106.

Kuroda, Tokubei〔黒田徳米〕：A new *Pleurotomaria* from Japan, with a note on a specimen of *P. rumphii* Schepman collected from Taiwan. *Venus: Jap. J. Malac.*, 18 (4), pp. 211–221, pls. 8–9. (With Japanese rés.) **271**

————：日本産イモガイ類〔Conid shells from Japan〕. *Ibid.*, 18 (4), pp. 284–302.

Maéda, Hiroshi : Statistical analysis of the influences of various lights upon the distribution of fishes in aqualium I. The influences of various lights upon the distribution of dark adapted fishes. *Bull. Jap. Soc. Sci. Fish.*, 21 (3), pp. 159–163.

Miyadi, Denzaburo & Habe, T.〔宮地伝三郎・波部忠重〕：瀬戸内海と外海との関係（1），内湾底生動物の比較〔Relation between the Seto Inland Sea and open sea (1). Comparison of benthic animals in bays〕. 海洋資源開発調査研究報告〔*Kaiyô-sigen Kaihatu Tyôsa Kenkyû Hôkoku*〕, No. 1, pp. 64–67.

Ohgushi, Ryoh-ichi〔大串龍一〕：潮間帯にすむ笠貝の習性，II. 2種の笠貝の帰家行動の解析〔Ethological studies on the intertidal limpets, II. Analytical studies on the homing behavior of two species of limpets〕. 日生態会誌〔*Jap. J. Ecol.*〕, 5 (1), pp. 31–35. (With English rés.) .... (Jap. **92**)

Ohsawa, Wataru & Tsukuda, Hiroko : Extruding response of the periwinkle, *Nodilittorina granularis* (Gray). *Journ. Inst. Polytech. Osaka City Univ.*, Ser. D (Biol.), 6, pp. 71–96. .... **272**

Research Group on Marine Biology, Kyoto Univ.〔京都大学海洋生物研究グループ〕：内湾に於ける魚類の発生階段と生活場所〔Habitats with relation to developmental stages of fishes in the bays〕. 生物科学〔*Biol. Sci.*〕, 特集号（生体と環境との相互連関）〔Sep. Vol.: *Interrelations between organisms and their environments*〕, pp. 68–72.

Sakai, Tune : On some rare species of crabs from Japan. *Bull. Biogeogr. Soc. Japan*, 16–19, pp. 106–113.

Shiino, Sueo M. : Copepods parasitic on Japanese fishes, 9. Family Chondracanthidae, subfamily Chondracanthinae. *Rep. Fac. Fish. Pref. Univ. Mie*, 2 (1), pp. 70–111.

TAKI, Iwao & HABE, Tadashige 〔滝 巖・波部忠重〕: Gastrochaenidae in Japan (日本産コツツガイ科). *Illust. Cat. Jap. Shells*, 2 (1), pp. 1–6, pl. 1. .... **265**

———— & ———— : Pholadidae in Japan (日本産ニオガイ科). *Ibid.*, 2 (2), pp. 7-16, pl. 2. .... **266**

TOKIOKA, Takasi 〔時岡 隆〕: 日本動物図鑑掲載海鞘類の再検討〔Revision of Ascidians described and illustrated in Japanese "Dobutu Zukan"〕. 動物雑〔*Zool. Mag.*〕, 64 (1), pp. 20–24. (With English rés.) .... (Jap. **86**)

———— : エボヤ (*Styela clava* Herdman) ヨーロッパ水域に産す〔Record of *Styela clava* from the European waters〕. *Ibid.*, 64 (6), p. 200. (With English rés.) .... (Jap. **93**)

———— : オオニシの胚殻計測の1例〔A measurement on protoconchs found in the egg-capsules of *Syrinx proboscidiferus* (Lamarck)〕. 貝類雑〔*Venus: Jap. J. Malac.*〕, 18 (4), pp. 278–282. (With English rés.) .... (Jap. **104**)

———— : 海鞘(ホヤ)類の採集及び整理法〔Methods of collecting and preserving ascidians〕. *Nature Study*, 1 (3/4), p. 13.

———— : Notes on some chaetognaths from the Gulf of Mexico. *Bull. Mar. Sci. Gulf & Caribbean*, 5 (1), pp. 52–65.

———— : Contributions to Japanese Ascidian fauna, XI. Sporadic memoranda (2). *Publ. Seto Mar. Biol. Lab.*, 4 (2/3), pp. 205–218, pls. 11–14. .... **254**

———— : On some plankton animals collected by the Syunkotu-maru in May-June 1954, I. Chaetognatha. *Ibid.*, 4 (2/3), pp. 219–225. .... **255**

———— : Ditto, II. Shells of Atlantidae (Heteropoda). *Ibid.*, 4 (2/3), pp. 227–236, pls. 15–16. .... **256**

———— : Shells of Atlantidae (Heteropoda) collected by the Sôyô-maru in the southern waters of Japan. *Ibid.*, 4 (2/3), pp. 237–250, pls. 17–18. .... **257**

———— : General consideration on Japanese Appendicularian fauna. *Ibid.*, 4 (2/3), pp. 251–261. .... **258**

———— : Ascidians from the Palao Islands, II. *Ibid.*, 5 (1), pp. 43–57, pls. 1–6. .... **268**

———— : On some plankton animals collected by the Syunkotu-maru in May-June 1954, IV. Thecosomatous pteropods. *Ibid.*, 5 (1), pp. 59–74, pls. 7–13. ... **269**

———— : Droplets from the plankton net, XVII. A small collection of chaetognaths and pelagic tunicates from the north eastern part of the Indian Ocean. XVIII. Short notes on a few appendicularians collected in the "Kurosio" off Siono-misaki. *Ibid.*, 5 (1), pp. 75–80. .... **270**

———— : On some plankton animals collected by the Syunkotu Maru in May-June 1954, III. Appendicularians. *Bull. Biogeogr. Soc. Japan*, 16–19, pp. 251–255. .... **273**

UMEZAKI, Isamu〔梅崎 勇〕: アイミドリの葉状体の発生学的研究〔A developmental study of the frond of *Brachytrichia Quoyi* (Ag.) Born. & Flah.〕. 植物分類地理〔*Acta Phytotax. Geobot.*〕, 16 (2), pp. 56–62. (With English rés.)... (Jap. **100**)

UTINOMI, Huzio〔内海富士夫〕: 日本産蔓脚類の研究, II. 地理的分布〔Studies on the Cirripedia of Japan, II. Geographical distribution〕. 日本生物地理学会会報〔*Bull. Biogeogr. Soc. Japan*〕, 16-19, pp. 113-123. (With English rés.)... (Jap. **94**)

————: 同上, III. 生態的事項〔Ditto, III. Ecological evidences〕, *Ibid.*, 16-19, pp. 124-134. (With English rés) .... (Jap. **95**)

————: 青ケ島の蔓脚類〔Cirripedia from Aoga-shima, Izu Islands〕, 資源研彙報〔*Misc. Rep. Res. Inst. Nat. Res.*〕, No. 38, pp. 149-150. .... (Jap. **96**)

————: アラフラ海真珠貝漁場より採れたナマコ類〔On holothurians from the pearl oyster ground of the Arafura Sea〕. 動物雑〔*Zool. Mag.*〕, 64 (9), pp. 273-276. (With English rés.) .... (Jap. **101**)

————: 調査未了の多い本邦の海産動物群〔A great number of marine animal groups insufficiently investigated occur in Japan〕. 動物分類学会会務報告〔*Business Rep. Jap. Soc. System. Zool.*〕, No. 9, pp. 8-10.

————: 臨海実習法; 浅海動物の観察, I. 南方篇〔Methods of courses of marine biology; Observations of shallow sea animals, I. Southern part of Japan〕. 生物学実験法講座〔*Series of techniques in biological researches*〕, 10C (1), pp. 1-41, pls. 1-23. 中山書店〔Nakayama Syoten〕, Tokyo.

————: On five new stoloniferans from Sagami Bay, collected by His Majesty the Emperor of Japan. *Jap. J. Zool.*, 11 (3), pp. 453-467. .... **251**

————: Two new species of *Xenia* from Kusimoto (Coelenterata, Alcyonaria). *Publ. Seto Mar. Biol. Lab.*, 4 (2/3), pp. 263-267. .... **259**

————: Report on the Pycnogonida collected by the Sôyô-maru Expedition made on the continental shelf bordering Japan during the years 1926-1930. *Ibid.*, 5 (1), pp. 1-42. .... **267**

WIESER, Wolfgang: A collection of marine nematodes from Japan. *Ibid.*, 4 (2/3), pp. 159-181. .... **252**

YAMANOUCHI, Toshihiko: On the poisonous substance contained in holothurians. *Ibid.*, 4 (2/3), pp. 183-203. .... **253**

YAMAZI, Isamu: Plankton investigation in inlet waters along the coast of Japan, VIII. The plankton of Miyazu Bay in relation to the water movement. *Ibid.*, 4 (2/3), pp. 269-284. .... **260**

————: Ditto, XVI. The plankton of Tôkyô Bay in relation to the water movement. *Ibid.*, 4 (2/3), pp. 285-309, pls. 19-20. .... **261**

————: Ditto, XVII. Seasonal succession of zooplankton in the inner area of Tanabe Bay from June to October, 1954. *Ibid.*, 4 (2/3), pp. 311-320. .... **262**

———— & HORIBATA, Taira: Ditto, XVIII. Seasonal succession of plankton in Taizi Bay in the years 1951-1953. *Ibid.*, 4 (2/3), pp. 321-336, pls. 21-22. ... **263**

Yanosuke Saika

(1888–1957)

YANOSUKE SAIKA

(1888–1957)

Mr. Yanosuke SAIKA was born on the 11th of March, 1888, at the village of Seto, now the town of Sirahama, where the Seto Marine Biological Laboratory is located. After finishing his schooling at the primary school, he engaged in the shipping which was the business of his family. From this experience as well as the naval service he acquired the knowledge on the sea both of the Japanese coast as well as abroad.

When the Kyoto Imperial University decided in 1921 to establish a marine station at Seto, he was recommended as the supervisor of the construction work, and continued his service at the Laboratory since its official opening in 1922 as the captain of the surveying boat *Nyûsin-maru* and the collector. Being a keen observer, Mr. SAIKA accumulated, by his own effort as well as by absorbing from researchers, wide and precise knowledge on the fauna and flora of the surrounding sea of the Laboratory. He was so well aquainted with the habitat and the life history of both animals and plants, that he could supply the specimens for the research and the aquarium exhibition as readily as a gardener could pick the flowers from his own garden. He was also a good and reliable advisor to be first consulted by students to start their marine ecological works. We estimated him as LoBIANCO had been by visitors of the Zoological Station at Naples, Italy.

As a keeper of the Aquarium, he was not only an excellent collector but took care of the animals with love. He drained once every day the aquarium which kept the sea-anemone *Actinia equina*, for the comfort of this inhabitant of the tidal zone, and it thus lived in good condition for a long time.

The Laboratory is situated on so-called the main street of typhoons, and it required a constant care, both during the daytime and at night, as well as hard work to keep boats in safety. It was chiefly due to his effort that no damage occurred either on persons or boats during his service at the Laboratory. We were in confidence that the boats and collecting equipments were always at the condition of stand-by both for the resident staffs and visiting researchers.

Publl. Seto Mar. Biol. Lab., VI (2), 1957. (Article 8)

He won official commendations once at the 50th Anniversary of the Kyoto University on the 25th of October, 1947, and twice at the 30th Anniversary of the Seto Marine Biological Laboratory on the 18th of October, 1952.

After his retirement from the office on the 31st of March, 1952, because of an old age, he remained as the honorary attendant and lived near the Laboratory, to which he showed unchanged affection. All visiting researchers enjoyed the talk with him on good old times as well as hard days in the history of the Laboratory. He was in good health both physically and mentally, and it was an astonishment of his friends that he should die of cancer so early, on the 10th of February, 1957, at the age of 69. Now he sleeps with his fathers at Hongakuzi Temple, well known as the 'Shell-Temple' for its collection of marine shells.

Denzaburo MIYADI
Director

REPORT ON THE MOLLUSCA CHIEFLY COLLECTED BY THE S. S. SÔYÔ-MARU OF THE IMPERIAL FISHERIES EXPERIMENTAL STATION ON THE CONTINENTAL SHELF BORDERING JAPAN DURING THE YEARS 1922–1930

PART 2. SCAPHOPODA[1][2]

Tadashige HABE

Amakusa Marine Biological Laboratory (Kyushu University)

With 11 Text-figures and 1 Table

In this second report the writer deals with 13 species of tooth shell or Scaphopoda which were collected from 66 stations during the survey of the continental shelf bordering Japan.

Class SCAPHOPODA

Family Dentaliidae

Genus *Dentalium* Linné 1758

Subgenus *Fissidentalium* Fischer 1885

1. *Dentalium* (*Fissidentalium*) *yokoyamai* Makiyama

1920 *Dentalium complexum* Yokoyama, Mem. Coll. Sci. Imp. Univ. Tokyo, **39** (6), p. 101, pl. 6, fig. 27 (non Dall).

1931 *Dentalium yokoyamai* Makiyama, Mem. Coll. Sci. Kyoto Imp. Univ., (B) **7** (1), p. 44, pl. 1, fig. 1.

1954 *Dentalium* (*Fissidentalium*) *yokoyamai* Kira, Illust. Jap. Shells, pl. 40, fig. 12.

Locality: St. 381, Off Owase, Kumano-Nada, 329 m.

Distribution: Tosa Bay, Shikoku to Kumano-Nada, Honshu.

Remarks: This shell is large and solid, slightly curved towards the posterior end, white and has the numerous distinct longitudinal ribs. The aperture is circular. The ventral fissure at the apex is narrow but rather long.

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[1] Contributions from the Seto Marine Biological Laboratory, No. 300.

[2] Contributions from the Amakusa Marine Biological Laboratory (Kyushu University), No. 108.

2. *Dentalium* (*Fissidentalium*) *lima* KURODA MS.

Locality: St. 286, Seno-umi Bank in Suruga Bay, 123 m.

Distribution: Tosa Bay, Shikoku to Suruga Bay, Honshu.

Remarks: This is an undescribed species closely allied to *D. yokoyamai.*

3. *Dentalium* (*Fissidentalium*) *hungerfordi* PILSBRY et SHARP

(Fig. 1)

1888 *Dentalium compressum* SOWERBY, Proc. Zool. Soc. London, p. 569, pl. 28, fig. 18 (non WATSON).
1897 *Dentalium hungerfordi* PILSBRY et SHARP, Man. Conch., **17**, p. 84, pl. 6, fig. 88.
1931 *Dentalium* (*Fissidentalium*) *hungerfordi* S. HIRASE, Jour. of Conch., **19**, p. 137, pl. 3, fig. 8.
1934 *Dentalium* (*Fissidentalium*) *hungerfordi* S. HIRASE, Coll. Jap. Shells, pl. 127, fig. 2.
1953 *Dentalium* (*Fissidentalium*) *hungerfordi* HABE, Gen. Jap. Shells, **4**, p. 293, fig. 749.
1954 *Dentalium* (*Fissidentalium*) *hungerfordi* KIRA, Illust. Jap. Shells, pl. 40, fig. 10.

Localities: St. 240, Off Zushi, Sagami Bay, 192 m; St. 384, Off Toba, the entrance of Ise Bay, 32–21 m.

Distribution: Tosa Bay, Shikoku to Sagami Bay, Honshu and China.

Remarks: This is quite characteristic in having the shell compressed dorsoventrally. The shell is fresh orange in colour and marks numerous longitudinal riblets all over the surface. The fissure is long and narrow.

Subgenus *Dentale* DA COSTA 1778

4. *Dentalium* (*Dentale*) *weinkauffi* DUNKER

(Fig. 7)

1877 *Dentalium weinkauffi* DUNKER, Malak. Bl., **24**, p. 68; Index Moll. Mar. Jap., p. 153, pl. 5, fig. 1 (1882).
1931 *Dentalium* (*Antalis*) *weinkauffi* S. HIRASE, Jour. of Conch., **19**, p. 135, pl. 3, fig. 4.
1934 *Denlalium* (*Antalis*) *weinkauffi* S. HIRASE, Coll. Jap. Shells, pl. 126, fig. 4.
1953 *Dentalium* (*Dentale*) *weinkauffi* HABE, Gen. Jap. Shells, **4**, p. 294, fig. 747.
1954 *Dentalium* (*Dentale*) *weinkauffi* KIRA, Illust. Jap. Shells, pl. 40, fig. 6.

Localities: St. 11. Off Chôshi, Chiba Pref., 375 m; St. 212, Off Tanabe, Wakayama Pref,, 181 m; St. 240, Off Zushi, Sagami Bay, 192 m; St. 319, Off Nobeoka, Miyazaki Pref., 210 m; St. 365, Off Hamashima, Mie Pref., 93 m; St 371, Off Atsumi Peninsula, Enshû-Nada, 84 m; St. 384, Off Toba, the entrance of Ise Bay, 32–21 m; St. 396, Off Tanabe, Wakayama Pref., 68 m; St. 470, Off Hakata Bay, Tsushima Strait, 73 m; St. 484, Off Yutani Bay, Yamaguchi Pref., 93 m; Sts. 491, 493 494 and 495, Off Hamada, Shimane Pref., 112 m, 124 m, 110 m and 146 m; Sts. 503 and 504, Off Oki in Japan Sea, 146 m and 106 m; St. 572, Off Noto Peninsula, 132 m.

Distribution: Kyushu, Shikoku and Honshu.

Remarks: The shell is long and narrow, slightly curved at the hinder part. The colouration is pale orange when fresh, while white when dead. The longitudinal ribs well developed in the posterior part are becoming obsolete to the anterior. The aperture is quite round and the fissure at the posterior end is absent.

5. *Dentalium* (*Dentale*) *rhabdotum* PILSBRY

(Fig. 11)

1905 *Dentalium rhabdotum* PILSBRY, Proc. Acad. Nat. Sci. Phila., **57**, p. 116, pl. 5, figs. 45–47.
1933 *Dentalium* (*Antalis*) *rhabdotum* KURODA et KIKUCHI, Venus, **4** (1), p. 8, pl. 1, figs. 1, 2.
1953 *Dentalium* (*Dentale*) *rhabdotum* HABE, Gen. Jap. Shells, **4**, p. 294, fig. 746.

Localities: St. 4, Off Katsu-ura, Chiba Pref., 287 m; St. 11, Off Chôshi, Chiba Pref., 375 m; St. 205, Off Shingû. Kumano-Nada; 224 m; St. 207, Off Kushimoto, Wakayama Pref., 229 m; St. 216, Off Kannoura, Kôchi Pref., 274 m; St. 240, Off Zushi, Sagami Bay, 192 m; St. 256, Off Shimoda, Sagami Bay, 549 m; Sts. 302 and 304, Off Toizaki, Miyazaki, Pref., 582 m and 241 m; St. 321, Off Nobeoka, Miyazaki Pref., 457 m; St. 366, Off Hamashima, Kumano-Nada, 494 m; St. 349, Off Ishima, Kii Strait, 152 m; St. 392, Off Ishima, Kii Strait, 61 m; St. 417, Off Yamakawa, Kagoshima Pref., 192 m; Sts. 469 and 470, Off Hakata Bay, Tsushima Strait, 91 m and 73 m; Sts. 477 and 479, Off Fusan, Korea Strait, 99 m and 148 m; Sts. 481 and 486, Off Tsushima, 143 m and 139 m; St. 495, Off Hamada, Shimane Pref., 146 m; St. 498, Off Shimane Peninsula, 139 m; Sts. 503 and 506, Off Oki in Japan Sea, 146 m and 176 m; Off Hamasaka, Hyôgo Pref., 183 m; St. 541, Off Yosa Peninsula, 150 m; Sts. 595, 599, 602 and 611, Off Sado in Japan Sea, 145 m, 181 m, 205 m and 143 m; Sts. 619 and 622, Off Tobishima in Japan Sea, 338 m and 218 m; St. 640, Off Tsugaru, Aomori Pref., 179 m.

Distribution: Kyushu, Shikoku and Honshu.

Remarks: This is the dull white shell with more or less blackish incrustation and is nearly straight but narrow. The surface is sculptured with the longitudinal ribs throughout, in each interval of which appear the secondary ribs. The aperture is circular and the shallow notch at the narrow posterior end is observed in the perfect specimen.

6. *Dentalium* (*Dentale*) *marukawai* OTUKA

1933 *Dentalium marukawai* OTUKA, Venus, **4**, p. 159, textfigs. a–f.

Locality: St. 425, Off Koshiki-jima, Kyushu, 300 m.

Distribution: Ryukyus, Kyushu and Tosa Bay, Shikoku.

Remarks: This species is related to *D.* (*D.*) *weinkauffi*, but differs from that species in more slender shell coloured in cream white.

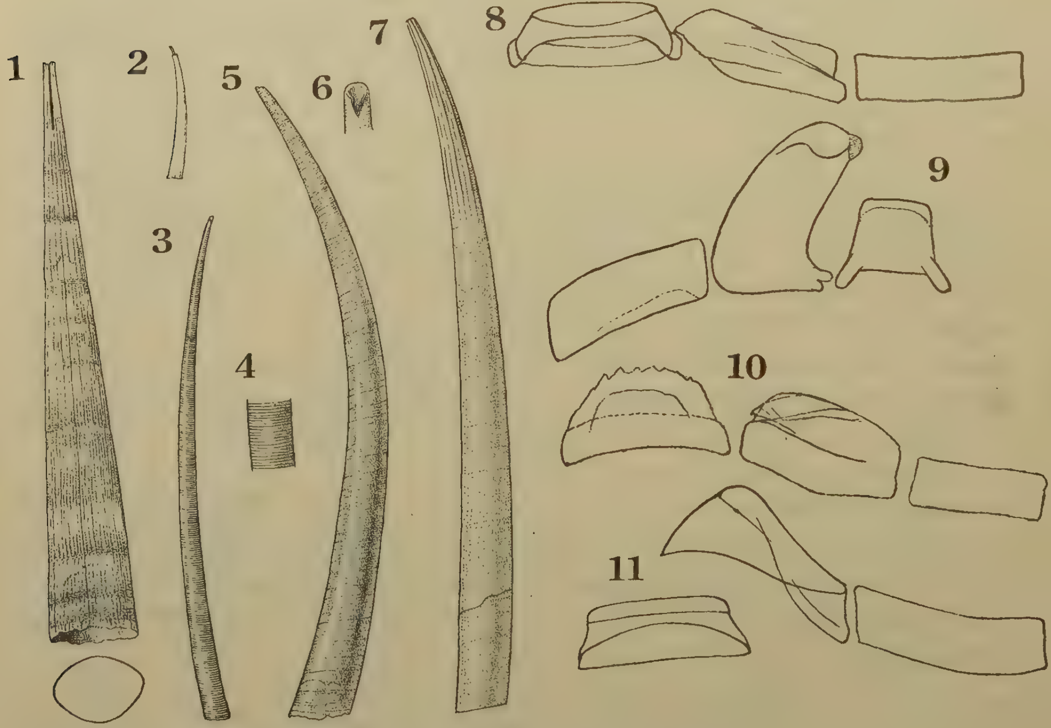
Subgenus *Laevidentalium* Cossmann 1888

7. *Dentalium* (*Laevidentalium*) *crocinum* Dall

(Figs. 5, 6)

1905 *Dentalium crocinum* Dall, Smiths. Misc. Coll., **50**, p. 169; Proc. U. S. Nat. Mus., **66** (17), p 16, pl. 27, fig. 6 (1925).
1953 *Dentalium* (*Laevidentalium*) *crocinum* Habe, Gen. Jap. Shells, **4**, p. 294, figs. 751–2.
1954 *Dentalium* (*Laevidentalium*) *crocinum* Kira, Illust. Jap. Shells, pl. 40, fig. 9.

Localities: St. 4, Off Katsu-ura, Chiba Pref., 287 m; St. 203, Off Owase, Kumano Nada, 249 m; St. 392, Off Ishima, Kii Strait, 61 m; St. 488, Off Hamada, Shimane Pref., 406 m.



Figs. 1–7. Shells: 1. *Dentalium* (*Fissidentalium*) *hungerfordi* Pilsbry et Sharp, 2. *D.* (*Episiphon*) *makiyamai* Kuroda et Kikuchi, 3. *Omniglypta cerina* (Pilsbry), 4. The enlarged surface sculpture of the same, 5. *D.* (*Laevidentalium*) *crocinum* Dall, 6. The apical opening of the same, 7. *D.* (*Dentale*) *weinkauffi* Dunker, 8–11. Radulae: 8. *D.* (*Fissidentalium*) *vernedei* Sowerby (not present in the collection of this survery) as an example of *Fissidentalium*, 9. *Entalina* (*Entalinopsis*) *nivosa* (Kuroda et Kikuchi), 10. *Omniglypta cerina* (Pilsbry), 11. *D.* (*Dentale*) *rhabdotum* Pilsbry.

Distribution: Shikoku and Honshu (north to Bôsô Peninsula and Off Hamada, on the Japan Sea coast).

Remarks: The shell is smooth and polished without any sculpture except growth lines, solid and reddish yellow in colour, gradually increasing in diameter to the mouth and gently curved. The aperture is entirely circular and the apex is notched on the ventral side.

8. *Dentalium* (*Laevidentalium*) *coruscum* PILSBRY

1905 *Dentalium coruscum* PILSBRY, Proc. Acad. Nat. Sci. Phila., **57**, p. 117, pl. 5, figs. 42, 43.
1933 *Dentalium* (*Laevidentalium*) *coruscum* KURODA et KIKUCHI, Venus, **4**, p. 10, pl. 1, fig. 7.

Localities: St. 395, Off Tanabe, Wakayama Pref., 46 m; Sts. 488 and 493, Off Hamada, Shimane Pref., 406 m and 124 m; St. 497, Off Shimane Peninsula, 143 m; St. 504, Off Oki in Japan Sea, 106 m.

Distribution: Shikoku (Tosa Bay); Honshu (off Wakayama Pref. to Kashima-Nada) and Japan Sea.

Remarks: This species is related to the preceding species, but differs from the latter in having the more slender white shell.

Subgenus *Fistiaria* STOLICZKA 1868

9. *Dentalium* (*Fistiaria*) *nipponicum* YOKOYAMA

1922 *Dentalium* (*Fistiaria*) *nipponicum* YOKOYAMA, Jour. Coll. Sci. Imp. Univ. Tokyo, **44** (1), p. 119, pl. 6, fig. 7.

Locality: St. 251, Off Itô, Sagami Bay, 165 m.

Distribution: Sagami Bay and Toyama Bay.

Remarks: This small species has thin, smooth and polished shell which curves slighlty. The apical slit is linear and rather long.

Subgenus *Episiphon* PILSBRY et SHARP 1897

10. *Dentalium* (*Episiphon*) *makiyamai* KURODA et KIKUCHI

(Fig. 2)

1927 *Dentalium* (*Episiphon*) *filum* MAKIYAMA, Mem. Coll. Sci. Kyoto Imp. Univ., (B) **3** (1), p. 58 (non SOWERBY).
1933 *Dentalium makiyamai* KURODA et KIKUCHI, Venus, **4** (1), p. 11, pl. 1, fig. 8.
1953 *Dentalium* (*Episiphon*) *makiyamai* HABE, Gen. Jap. Shells, 4, p. 296, fig. 767.

Localities: St. 4, Off Katsu-ura, Chiba Pref., 287 m; St. 199, Off Hamashima, Kumano-Nada, 207 m; St. 371, Off Atsumi Peninsula, Enshû-Nada, 84 m; St. 392, Off Ishima, Kii Strait, 61 m; Sts. 432 and 452, Off Gotô Islands, 148 m and1 54 m; Sts. 459

and 481, Off Tsushima, 115 m and 143 m ; St. 484, Off Yutani Bay, Yamaguchi Pref., 93 m ; Sts. 488 and 492, Off Hamada, Shimane Pref., 406 m and 132 m ; Sts. 503 and 504, Off Oki in Japan Sea, 146 m and 106 m ; St. 580, Off Nanao, Toyama Bay, 135 m.

Distribution : Kyushu, Shikoku and Honshu.

Remarks : This is characterized by the apex with a narrow tube projection from the centre of the disc, closing the posterior end. The shell is smooth and polished, orange red in colour.

Genus *Omniglypta* KURODA et HABE 1953

11. *Omniglypta cerina* (PILSBRY)

(Figs. 3, 4, 10)

1905 *Dentalium* (*Rhabdus*) *cerinum* PILSBRY, Proc. Acad. Nat. Sci. Phila., 57, p. 117, pl. 5, figs. 40, 41.

1953 *Omniglypta cerina* HABE, Gen. Jap. Shells, **4**, p. 296, figs. 753, 754.

Locality : St. 452, Off Gotô Islands, Kyushu, 154 m.

Distribution : Tosa Bay, Shikoku ; Honshu and Off Goto Islands, Kyushu.

Remarks : This is quite characteristic in having the densely set annular sculpture all over the surface. The shell is thin and nearly straight and white in colour. The aperture is circular.

Family Siphonodentaliidae

Genus *Entalina* MONTEROSATO 1872

Subgenus *Entalinopsis* nov.

This new subgenus is closely related to *Entalina s. st.* in the shape of shell, but in the former the primary longitudinal costae are generally six in number throughout the shell, while in the latter they are five near the posterior end but the dorsal one of them becomes obsolete quickly, forming the four angled section by the other four and these four costae are reduced away near the aperture in some species. The radular feature also discriminates between *Entalina* and *Entalinopsis*. In the latter, the central tooth is small, trapezoidal slightly narrowed anteriorly and has a small projection on the base of each side, which lacks in *Entalina*. The lateral tooth is stout, about twice as long as broad and has two obsoletely placed cusps in *Entalinopsis* while in *Entalina* the base of lateral tooth is broad and two large and several minute cusps are provided on the anterior margin of it. The marginal is transversely broad, trapezoidal in shape, presenting no denticulation as well as in that of *Entalina*.

Type species : *Dentalium nivosum* KORODA et KIKUCHI.

12. *Entalina* (*Entalinopsis*) *nivosa* (KURODA et KIKUCHI)

(Fig. 9)

1933 *Dentalium nivosum* KURODA et KIKUCHI, Venus, **4** (1), p. 7, pl. 1, figs. 9, 10, textfigs. 1, 2.
1940 *Dentalium tugaruense* NOMURA et HATAI, Saitô Hô-on Kai Mus. Res. Bull., **19**, p. 73, pl. 3, fig. 4.

Localities: St. 11 and 12, Off Chôshi, Chiba Pref., 375 m and 325 m; St. 211, Off Tanabe, Wakayama Pref., 190 m; St. 240, Off Zushi, Sagami Bay, 192 m; St. 286, Seno-umi Bank in Suruga Bay, 123 m; St. 300, Off Toizaki, Miyazaki Pref., 110 m; St. 321, Off Nobeoka, Miyazaki Pref., 457 m; St. 324, Off Uwajima, Ehime Pref., 106 m; St. 327, Off Okinoshima, Kochi Pref., 216 m; St. 343, Off Cape Muroto, Kochi Pref., 366 m; St. 365, Off Hamashima, Kumano-Nada, 93 m; St. 371, Off Atsumi Peninsula, Enshu-Nada, 84 m; St. 384, Off Toba, the entrance of Ise Bay, 32–21 m; St. 392, Off Ishima, Kii Strait, 61 m; St. 432, Off Goto Islands, 148 m; St. 470, Off Hakata Bay, Tsushima Strait, 73 m; St. 481, Off Fusan, Korea Strait, 143 m. Sts. 488, 491, 493 and 494, Off Hamada, Shimane Pref., 406 m, 112 m, 124 m and 110 m; St. 498, Off Shimane Peninsula, 139 m; Sts. 503 and 504, Off Oki in Japan Sea, 146 m and 106 m; St. 520, Off Shimane Peninsula, 75 m.

Distribution: Bungo Strait between Kyushu and Shikoku to off Chôshi, Chiba Pref. and off Gotô Islands to off Tsugaru Peninsula.

Remarks: This species has been considered a member of the genus *Dentalium* together with *Entalina habutae* until to-day, but the radula of this species is of the *Siphonodentalium*-type in having the small central tooth which is higher than broad. Therefore it should be transferred to the family Siphonodentaliidae from the family Dentaliidae. The shell is white and slightly curved, the section of which is six-angled with a distinct rib at each angle. The interspaces are concave near the apex and becoming flat in the posterior portion and four to six riblets appear on each interspace. The apical opening is simple.

13. *Entalina* (*Entalinopsis*) *habutae* (KURODA et KIKUCHI)

1933 *Dentalium habutae* KURODA et KIKUCHI, Venus, **4** (1), p. 8, pl. 1, figs. 12, 13, textfigs. 3, 4.

Localities: St. 12, Off Chôshi, Chiba Pref., 325 m; St. 27, Off Taira, Fukushima Pref., 497 m; St. 212, Off Tanabe, Wakayama Pref., 181 m; St. 221, Off Aki, Tosa Bay, 209 m; St. 286, Seno-umi Bank in Suruga Bay, 123 m; St. 302, Off Toizaki, Miyazaki Pref., 582 m; St. 321, Off Nobeoka, Miyazaki Pref., 457 m; St. 324, Off Uwajima, Ehime Pref., 106 m; St. 366, Off Hamashima, Kumano-Nada. 494 m; St. 384, Off Toba, the entrance of Ise Bay, 32–21 m; St. 417, Off Makurazaki, Kagoshima Pref., 192 m; Sts. 459 and 481, Off Tsushima, 115 m and 143 m; St. 484, Off Yuya Bay, Yamaguchi Pref., 93 m; Sts. 486 and 488, Off Hamada, Shimane Pref., 139 m and 406 m; Sts. 491 and 498, Off Shimane Peninsula, 112 m and 139 m; St. 503, Off Oki in Japan Sea, 146 m; St. 520, Off Shimane Peninsula, 75 m.

Distribution: Kyushu, Shikoku and Honshu (North to off Taira on the Pacific coast and to Toyama Bay on the Japan Sea coast).

Remarks: This is a small, white, slender shell which is slightly curved and six- or seven-angled with a distinct rib at each angle. The interspaces are concave at the apex but flattish toward the aperture, the surface of which are reticulated consisting of about twenty minute longitidinal striae intersected by fine growth lines.

Both *E. nivosa* and *E. habutae* are common on the continental shelf bordering Japan and are found in the Pleistocene deposits of Moeshima in Kagoshima Bay of Kyushu.

List of species collected, arranged by stations.

Station No.	Date	Locality		Depth (m)	Bottom water temp. (C°)	Bottom character	Species of scaphopods
		Lat. N.	Long. E.				
4	1926 June 16	34°37′30″	140°06′00″	287	8.9	S	*D.* (*D.*) *rhabdotum* *D.* (*L.*) *crocinum* *D.* (*E.*) *makiyamai*
11	June 23	35 25 00	141 10 40	375	8.2	S.G	*D.* (*D.*) *weinkauffi* *D.* (*D.*) *rhabdotum* *E. nivosa*
12	do	35 34 45	141 13 35	325	7.2	m.S	*E. nivosa* *E. habutae*
27	July 2	37 17 20	141 41 00	497	3.9	m.S	*E. habutae*
199	1927 July 11	34 10 30	136 54 30	207	9.7	s.M	*D.* (*E.*) *makiyamai*
203	July 12	33 59 20	136 21 40	249	11.0	m.S	*D.* (*L.*) *crocinum*
205	do	33 47 30	136 09 30	224	11.3	M.S. Sh	*D.* (*D.*) *rhabdotum*
207	July 13	33 30 40	135 57 15	229	11.7	S	*D.* (*D.*) *rhabdotum*
211	July 14	33 33 30	135 19 00	190	14.8	G Sh	*E. nivosa*
212	do	33 37 50	135 10 30	181	14.3	f.S	*D.* (*D.*) *weinkauffi* *E. habutae*
216	July 19	33 26 00	134 22 00	274	10.5	M	*D.* (*D.*) *rhabdotum*
221	July 20	33 20 30	135 54 00	209	14.1	m.S	*E. habutae*
240	Nov. 6	35 10 30	139 32 35	192	15.2	f.S.M	*D.* (*F.*) *hungerfordi* *D.* (*D.*) *weinkauffi* *D.* (*D.*) *rhabdotum* *E. nivosa*
251	Nov. 9	34 59 30	139 10 00	165	15.8	c.S.Sh	*D.* (*F.*) *nipponicum*
256	Nov. 10	34 44 25	139 08 30	549	7.2	Pum.St.	*D.* (*D.*) *rhabdotum*
286	July 4	34 36 10	138 26 30	123	14.3	s.M	*D.* (*F.*) *lima* *E. nivosa* *E. habutae*
300	1928 July 11	31 18 50	131 19 30	110	17.5	s.M	*E. nivosa*
302	July 12	31 05 10	131 32 10	582	6.2	M	*D.* (*D.*) *rhabdotum* *E. habutae*

(Continued)

Station No.	Date	Locality		Depth (m)	Bottom water temp. (C°)	Bottom character	Species of scaphopods
		Lat. N.	Long. E.				
304	1928 July 12	31°24′40″	131°34′40″	241	14.3	s.M	*D.* (*D*) *rhabdotum*
319	July 16	32 35 50	131 57 38	210	13.1	S.Sh	*D.* (*D.*) *weinkauffi*
321	do	32 39 55	132 12 05	457	8.2	M	*D.* (*D.*) *rhabdotum* *E. nivosa* *E. habutae*
324	July 21	32 51 35	132 22 55	106	17.5	S	*E. nivosa* *E. habutae*
327	July 21	32 41 20	132 30 10	216	13.1	S.Sh	*E. nivosa*
343	July 28	33 11 30	134 03 00	366	9.1	G.M.Sh	*E. nivosa*
349	Aug. 1	33 42 50	134 50 30	152	18.4	G.M	*D.* (*D.*) *rhabdotum*
365	Aug. 10	34 12 09	136 44 28	93	15.7	M	*D.* (*D.*) *weinkauffi* *E. nivosa*
366	do	34 05 40	136 49 00	494	6.1	M	*D.* (*D.*) *rhabdotum* *E. habutae*
371	Aug. 13	34 30 15	137 21 45	84	17.3	M	*D.* (*D.*) *weinkauffi* *D.* (*E.*) *makiyamai* *E. nivosa*
381	1927 Dec. 3	34 03 45	136 32 45	329	—	—	*E.* (*F.*) *yokoyamai*
384	Dec. 4	34 29 15	136 57 45	38–21	—	—	*D.* (*F.*) *hungerfordi* *D.* (*D.*) *weinkauffi* *E. nivosa* *E. habutae*
392	1928 Feb. 23	33 51 00	134 52 40	61	—	S	*D.* (*D.*) *rhabdotum* *D.* (*L.*) *crocinum* *D.* (*E.*) *makiyamai* *E. nivosa*
395	Feb. 26	33 43 20	135 16 00	46	—	S	*D.* (*L.*) *coruscum*
296	Feb. 27	33 44 40	135 09 00	68	—	M	*D.* (*D.*) *weinkauffi*
417	1929 July 14	31 10 15	130 26 00	192	13.9	s.M.G	*D.* (*D.*) *rhabdotum* *E. habutae*
425	July 15	31 48 45	129 42 30	300	11.9	R	*D.* (*D.*) *marukawai*
432	July 18	32 40 15	129 18 00	148	16.0	s.M.Sh	*D.* (*E.*) *makiyamai* *E. nivosa*
452	July 22	32 43 15	127 44 30	154	14.2	m.S	*O. cerina*
459	July 23	34 09 00	128 49 45	115	14.6	M.S	*D.* (*E.*) *makiyamai* *E. habutae*
469	July 25	34 09 10	130 07 00	91	18.5	c.S.R	*D.* (*D.*) *rhabdotum*
470	do	33 56 40	130 10 10	73	20.7	S.P.	*D.* (*D.*) *weinkauffi* *D.* (*D.*) *rhabdotum* *E. nivosa*
477	July 28	34 57 25	129 06 30	99	14.3	P.M.Sh	*D.* (*D.*) *rhabdotum*
479	Aug. 8	35 20 18	129 42 40	148	9.9	s.M	*D.* (*D.*) *rhabdotum*
481	do	35 16 38	130 10 00	143	9.1	S	*D.* (*D.*) *rhabdotum* *D.* (*E.*) *makiyamai* *E. nivosa* *E. habutae*

(Continued)

Station No.	Date	Locality		Depth (m)	Bottom water temp. (C°)	Bottom character	Species of scaphopods
		Lat. N.	Long. E.				
484	1929 Aug. 9	34°29′30″	131°00′20″	93	21.0	S	*D.* (*D.*) *weinkauffi* *D.* (*E.*) *makiyamai* *E. habutae*
486	Aug. 11	35 12 20	130 57 30	139	5.1	S	*D.* (*D.*) *rhabdotum* *E. habutae*
488	do	35 35 20	130 46 20	406	1.7	M	*D.* (*L.*) *crocinum* *D.* (*E.*) *makiyamai* *E. nivosa* *E. habutae*
491	Aug. 12	35 22 10	131 23 50	112	9 6	M	*D.* (*D.*) *weinkauffi* *E. nivosa* *E. habutae*
492	do	35 03 30	131 32 10	132	17.7	m.S	*D.* (*E.*) *makiyamai*
493	do	34 57 00	131 52 20	124	18.1	m.S	*D.* (*D.*) *weinkauffi* *D.* (*L.*) *coruscum* *E. nivosa*
494	Aug. 12	35 02 00	132 05 30	110	20.9	m.S	*D.* (*D.*) *weinkauffi* *E. nivosa*
495	Aug. 14	35 17 00	132 10 20	146	15.2	S	*D.* (*D.*) *weinkauffi* *D.* (*D.*) *rhabdotum*
497	do	35 28 12	132 30 50	143	15.2	f.S.	*D.* (*L.*) *coruscum*
498	Aug. 15	35 41 45	132 46 30	139	13.7	m.S	*D.* (*D.*) *rhabdotum* *E. nivosa* *E. habutae*
503	Aug. 18	36 05 05	133 16 28	146	16.3	S	*D.* (*D.*) *weinkauffi* *D.* (*D.*) *rhabdotum* *D.* (*E.*) *makiyamai* *E. nivosa* *E. habutae*
504	do	36 14 45	133 04 45	106	18.6	Sh.G	*D.* (*D.*) *weinkauffi* *D.* (*L.*) *coruscum* *D.* (*E.*) *makiyamai* *E. nivosa*
506	do	36 25 00	133 02 00	176	3.3	m.S	*D.* (*D.*) *rhabdotum*
520	Aug. 23	35 43 00	133 07 30	75	23.3	S	*E. nivosa* *E. habutae*
530	Aug. 24	35 45 15	134 31 45	183	2.9	M.S	*D.* (*D.*) *rhabdotum*
541	Aug. 25	35 51 18	135 10 00	150	7.3	S	*D.* (*D.*) *rhabdotum*
572	1930 July 27	37 52 55	137 00 45	132	16.8	R	*D. weinkauffi*
580	July 29	37 17 50	137 17 10	135	14.2	S	*D.* (*E.*) *makiyamai*
595	Aug. 8	37 44 10	138 12 15	145	15.2	R	*D.* (*D.*) *rhabdotum*
599	Aug. 9	38 18 23	138 21 55	181	12.1	m.S	*D.* (*D.*) *rhabdotum*
602	do	38 47 00	138 34 30	205	4.7	R	*D.* (*D.*) *rhabdotum*
611	Aug. 13	38 20 40	138 54 00	143	12.4	S.Sh	*D.* (*D.*) *rhabdotum*
619	Aug. 14	39 16 27	139 29 15	338	4.4	R.G	*D.* (*D.*) *rhabdotum*
622	Aug. 15	39 23 34	139 50 00	218	5.5	s.M	*D.* (*D.*) *rhabdotum*
640	Aug. 22	40 35 45	139 47 00	179	11.4	M	*D.* (*D.*) *rhabdotum*

CHAETOGNATHS COLLECTED BY THE SÔYÔ-MARU IN THE YEARS 1934 AND 1937–1939[1]

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With one Text-figure and 2 Tables

About sixty plankton samples collected by the Sôyô-maru, a surveying ship of the Central Fisheries Experimental Station in Tokyo, in the years 1934 and 1937–1939 in the waters chiefly along the Pacific coasts of Japan and China (Fig. 1) were examined for the purpose to contribute to clear up the distribution of chaetognaths in the western part of the Pacific. They were all collected vertically from 50 m to the surface by KITAHARA's quantitative net which is a modified HENSEN's net in miniature, 25 cm in diameter of the mouth and 100 cm in length. The following seventeen species were identified in the present material.

1. *Sagitta hexaptera*
2. *Sagitta enflata*
3. *Sagitta elegans*
4. *Sagitta bipunctata*
5. *Sagitta bedoti*
6. *Sagitta pulchra*
7. *Sagitta ferox*
8. *Sagitta robusta*
9. *Sagitta serratodentata pacifica*
10. *Sagitta serratodentata atlantica* f. *pseudoserratodentata*
11. *Sagitta neglecta*
12. *Sagitta regularis*
13. *Sagitta crassa*
14. *Sagitta minima*
15. *Sagitta decipiens*
16. *Pterosagitta draco*
17. *Krohnitta pacifica*

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The details of the occurrence of respective species are given in Table 2 at the end of this article.

Before going further, I want to express my hearty thanks to Prof. H. AIKAWA who afforded me facilities for examining these samples.

Chaetognaths in Respective Sections of the Surveyed Area

1. *Okhotsk Sea*: Only a single species *Sagitta elegans* occurred.

2. *More northern waters than 40°N*: In the northern waters affected by the cold current "Oyasio", the fauna in the surface water shallower than 50 m is represented solely by *Sag. elegans*. However, in the southern part of this area, where the warm current "Kurosio", the cold current "Oyasio" and probably a considerable amount of the coastal water are mingled one another in various degrees according to the oceanographic conditions, some warm-water species are added to the fauna; among these *Sag. bedoti* is the most dominant one.

3. *Waters off the north-eastern Honsyû, south to 40°N*: In this region where the "Kurosio" encounters with the "Oyasio" and turns to the east, the fauna is characterized by the occurrence of abundant *Sag. bedoti*. Of course, a few specimens of *Sag. elegans* can be found in the northern part of this region. The southern-most record of *Sag. elegans* in the present material was found at St. 5 (34°36′ N, 144°04′ E) where a single 23 mm long individual was detected in the sample. As the coastal water mass might be induced out by the eastwards strong current, a small number of the coastal-water species *Sag. crassa* are found at some stations far off the coast as shown in the column of St. 5 in the table.

4. *Waters off the south-western Honsyû, including* (5) *Sagami Bay*: In this region, *Sag. bedoti* occurs more frequently and abundantly at stations near the coast than at far offshore stations. However, it occurs in a considerable number at some stations far south off Kii Peninsula. Possibly, this is due to the fact that the "Kurosio" turns sharply to the south near the south end of Kii Peninsula and flows along a large water mass of slightly lower temperature, which stays there for a long time; and resultantly an anticlockwise current produced along the periphery of this less warm water mass induces out the coastal water to far offshore stations. Usually, the proportion of *Sag. enflata* increases in this area as compared with that in the preceding region and it is the same as to *Sag. serratodentata pacifica*. Fourteen species were identified in samples from this section.

6. *Southern waters off Kyûsyû*: The composition of the fauna is nearly the same as in the preceding section, except for that the proportion of *Sag. bedoti* seems to fluctuate more conspicuously and proportions of *Sag. serratodentata pacifica* and *Sag. robusta* increase considerably in this section.

7. *East China Sea*: Here the occurrence of abundant *Sag. bedoti* at St. 40 and the absence of this species at Stations 120 and 125 are noticeable.

8. *Taiwan Straits*: Eleven species in two samples. *Sag. bedoti* was found in a considerable number.

9. *South China Sea*: *Sag. bedoti* occurs rather numerously at the northern stations near Taiwan Straits, while it decreases rather sharply at the southern stations around Hainan Island. The occurrence of comparatively rich *Sag. robusta* in this region should be noteworthy.

Throughout the whole material, the frequency of occurrence of respective species varies considerably according to sections as shown in Table 1.

Table 1.
Frequency of occurrence of respective species in each section of the surveyed area (0–50m).

Section number	1 (2 samples)	2 (13 sam.)	3 (7 sam.)	4 (13 sam.)	5 (6 sam.)	6 (6 sam.)	7 (4 sam.)	8 (2 sam.)	9 (9 sam.)	Frequency of occurence throughout the warm-water regions (53 sam.)
1. *Sag. hexaptera*	—	—	43	38	50	50	—	50	11	30
2. *Sag. enflata*	—	15	71	85	100	100	75	100	100	83
3. *Sag. elegans*	100	54	14	—	—	—	—	—	—	2
4. *Sag. bipunctata*	—	8	29	69	17	50	—	50	11	34
5. *Sag. bedoti*	—	46	100	92	100	67	50	100	67	85
6. *Sag. pulchra*	—	—	14	—	—	17	—	—	—	4
7. *Sag. ferox*	—	—	29	69	67	83	75	100	56	57
8. *Sag. robusta*	—	8	57	77	50	100	—	100	100	66
9. *Sag. serratodentata pacifica*	—	—	43	31	67	83	50	50	33	42
10. *Sag. serratodentata atlantica* f. *pseudoserratodentata*	—	—	—	—	33	—	—	—	—	4
11. *Sag. neglecta*	—	—	14	—	—	—	50	50	44	15
12. *Sag. regularis*	—	—	—	15	33	—	—	100	11	13
13. *Sag. crassa*	—	—	14	15	50	17	25	50	22	21
14. *Sag. minima*	—	—	14	—	17	—	—	—	—	4
15. *Sag. decipiens*	—	—	—	—	17	—	—	—	—	2
16. *Pterosag. draco*	—	—	—	15	67	—	—	100	—	15
17. *Ktta. pacifica*	—	—	—	8	—	—	50	—	22	9
Number of species	1	5	12	11	13	9	7	11	11	

Among the results obtained, the distribution of *Sag bedoti* seems to be one of the most interesting phenomena. This species occurs commonly in the Indian Ocean and the waters of the Siboga-area and goes to the north along the coast of the continent to the Japanese waters. However, it is practically or quite absent in the water of the North Equatorial Current (TOKIOKA 1942, 1954 and 1955), although the minor form of this species (*Sag. bedoti* f. *minor*) occurs also in the limited area of the eastern equatorial Pacific along the western coasts of the Central and northern South Americas (BIERI 1957).

In South China Sea, it is not so abundant as in other waters. For instance, it is recorded from the coastal waters of Annam (SERÈNE 1937), but there it occupies only a small part of the chaetognath fauna (HAMON 1956): the minor form occurred in the Bay of Nhatrang-Cauda at the frequency of 6·76%, but it occupied merely 1(−)∼1.7% of the whole population. Around the Philippine Islands, it was found only in four of the forty-six samples collected during the Albatross Expedition 1907–1910 (MICHAEL 1919). However, it increases in number in the northern part of the sea and reaches the dense population in the western half of East China Sea and the southern half of the Yellow Sea (TOKIOKA 1940). The scantiness of the present species in South China Sea may possibly be caused by the influence of the strong influx of the North Equatorial Current which carries no *Sag. bedoti*.

The water of East China Sea and the Yellow Sea may be induced out eastwards by "Kurosio" in various degrees and supplies *Sag. bedoti* to the coastal waters along the main island of Japan; there the species thrives considerably and the density reaches to the maximum in the area where the warm "Kurosio" and cold "Oyasio" encounter with each other. Then the species is carried to the east approximately along the 40° N line by the strong eastward current of "Kurosio", diminishing gradually in number and at last quite disappears in the pure oceanic water of the Pacific. So far as I am aware, the eastern-most limit of the distribution of *Sag. bedoti* is 161°39′ E and the northern-most limit is 44°06′ N. Many data about the distribution of this species in the "Kurosio" along the Pacific coast of Japan are now being accumulated in the oceanographic reports published by the meteorological department of Japan and these data seem also to affirm the idea that *Sag. bedoti* occurs, in the surveyed regions, more abundantly near the coast, but decreases remarkably towards the open sea. Thus, it seems very possible that *Sag. bedoti* can be used as an indicator to distinguish the water mass of the Indo-Malayan waters or that along the coasts of China and Japan from the pure oceanic water of the Pacific. The detailed data about this problem will be discussed fully in a future paper.

Situations of Stations

—— 1934 ——

Station	Date	Situation
6	Aug. 3	37°57′ N, 141°32′ E
11	Aug. 7	39°48′ N, 149°41′ E
13	Aug. 8	40°18′ N, 151°48′ E
15	Aug. 9	40°47′ N, 153°53′ E
17	Aug. 9	41°15′ N, 155°56′ E
N	Dec. 13	N.W. off Niizima

—— 1937 ——

Station	Date	Situation
13	Aug. 13	41°16,0′ N, 144°29,5′ E
40	Aug. 24	46°10,0′ N, 153°26,0′ E
57	Sept. 3	49°52,0′ N, 153°41,0′ E
68	Sept. 6	45°03,5′ N, 145°38,0′ E
71	Sept. 8	43°19,0′ N, 146°24,0′ E
78	Sept. 14	38°13′ N, 142°19′ E (off Kinka-zan)
	—— 1938 ——	
2	May 19	33°35,7′ N, 138°09,5′ E
7	May 21	31°05,0′ N, 138°24,0′ E
23	May 28	32°34,5′ N, 136°04,0′ E
29	May 29	30°13,3′ N, 136°41,2′ E (near Kinan-syô)
47	Jun. 3	31°31,2′ N, 134°12,5′ E
48	Jun. 4	30°48,5′ N, 134°08,5′ E
52	Jun 5	29°50,5′ N, 133°21,5′ E
72	Jun. 10	31°05,8′ N, 132°32,3′ E
84	Jun. 18	29°30,0′ N, 131°45,0′ E
95	Jun. 22	28°50,9′ N, 130°57,0′ E
98	Jun. 22	29°47,8′ N, 130°53,8′ E
103	Jun. 23	30°45,0′ N, 130°42,1′ E
5	Aug. 7	34°36,0′ N, 144°04,0′ E
9	Aug. 8	37°58,0′ N, 144°06,5′ E
13	Aug. 10	41°16,5′ N, 144°13,0′ E
37	Aug. 20	45°25,0′ N, 150°02,0′ E
43	Aug. 22	46°48,3′ N, 153°50,5′ E
46	Aug. 23	49°14,2′ N, 157°05,0′ E
60	Aug. 30	44°53,0′ N, 149°23,0′ E
77	Sept. 9	39°03,0′ N, 142°46,0′ E
	—— 1939 ——	
5	Jun. 5	32°55,0′ N, 138°02,5′ E
10	Jun. 6	30°52,0′ N, 136°11,0′ E
18	Jun. 8	33°18,0′ N, 135°36,5′ E
21	Jun. 8	32°22,5′ N, 134°32,5′ E
25	Jun. 9	31°16,7′ N, 132°43,2′ E
30	Jun. 12	30°51,2′ N, 130°22,0′ E
35	Jun. 12–13	30°05,5′ N, 127°30,0′ E
40	Jun. 16	29°41,0′ N, 125°09,5′ E

Station	Date	Situation
50	Jun. 21	25°31,6′ N, 121°44,6′ E
55	Jun. 24	25°00,5′ N, 120°30,5′ E
59	Jun. 26	23°34,0′ N, 118°46,8′ E
65	Jun. 29	21°45,0′ N, 115°32,0′ E
70	Jul. 2	20°30,0′ N, 113°00,0′ E
75	Jul. 2	20°14,7′ N, 110°58,1′ E
80	Jul. 6	20°55,0′ N, 108°31,5′ E
84	Jul. 7	18°35,0′ N, 108°01,8′ E
88	Jul. 7	17°00,0′ N, 109°01,0′ E
92	Jul. 10	17°15,3′ N, 110°29,8′ E
95	Jul. 11	18°16,0′ N, 111°07,8′ E
120	Jul. 23	25°26,0′ N, 124°01,0′ E
125	Jul. 24	25°55,0′ N, 126°35,0′ E
21	Aug. 29	42°05,0′ N, 148°49,0′ E
26	Aug. 31	41°58,5′ N, 154°14,0′ E
77	Sept. 19	38°57,0′ N, 143°00,0′ E

REFERENCES

BIERI, R. (1957): The chaetognath fauna off Peru in 1941. Pacific Science, Vol. XI, No. 3, pp. 255–264.

HAMON, M. (1956): Chétognathes recueillis dans la Baie de Nhatrang-Cauda (Viet-Nam). Bull. Mus. Nation. Hist. Nat., Tome XXVIII, No. 5, pp. 466-473.

MICHAEL, El. L. (1919): Report on the Chaetognatha, collected by the United States Fisheries Steamer "Albatross" during the Philippine Expedition 1907–1910. U. S. Nat. Mus., Bull. 100, Vol. 1, Pt. 4.

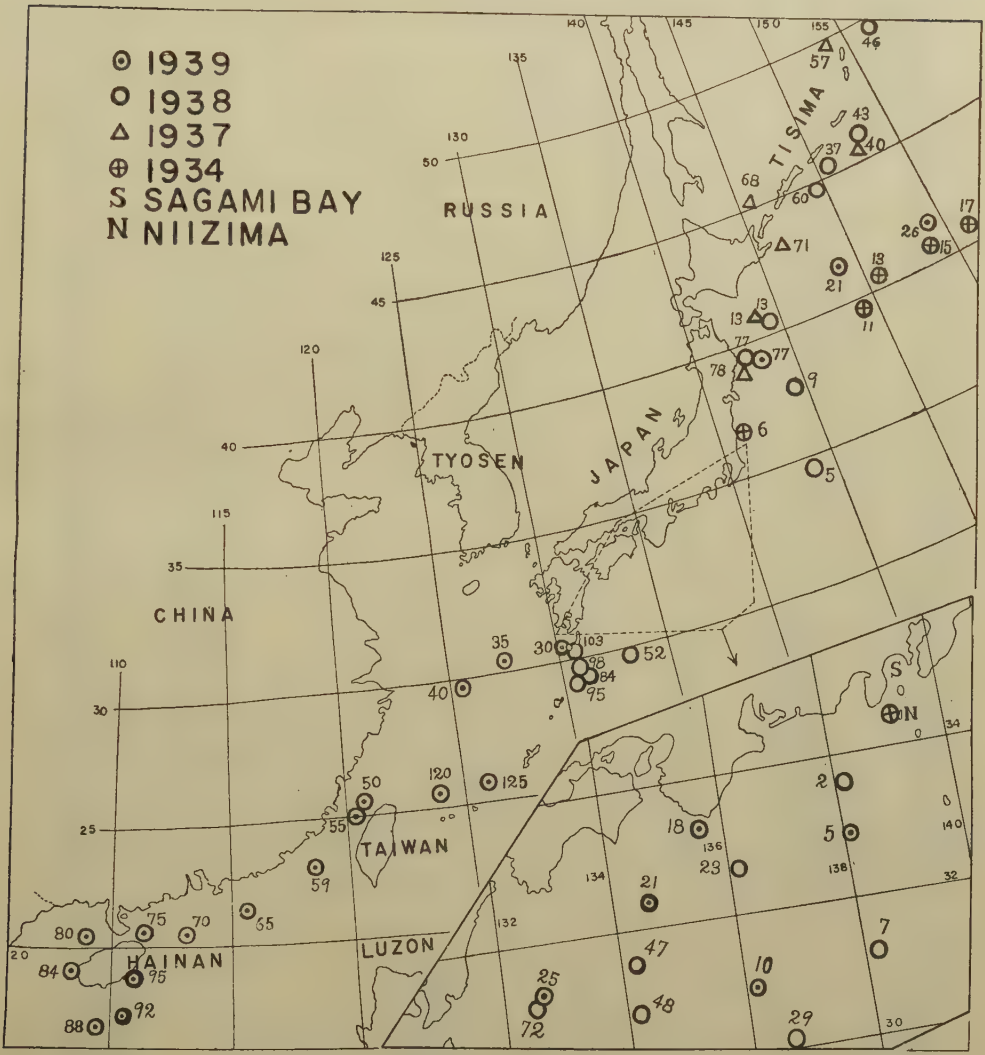
SERÈNE, R. (1937): Inventaire des invertébrés marins de l'Indochine (1re liste). Note Institut Océanographique de l'Indochine, 30e. Chaetognatha, p. 30.

TOKIOKA, T. (1940): The chaetognath fauna of the waters of western Japan. Rec. Oceanogr. Wks. in Japan, Vol. XII, No. 1, pp. 1–22.

——— (1942): Systematic studies of the plankton organisms occurring in Iwayama Bay, Palao. III. Chaetognaths from the Bay and adjacent waters. Palao Trop. Biol. Sta. Studies, Vol. II, No. 3, pp. 527–548.

——— (1954): Droplets from the Plankton Net. XVI. On a small collection of chaetognaths from the central Pacific. Publ. Seto Mar. Biol. Lab., Vol. IV, No. 1, pp. 99–102.

——— (1955): On some plankton animals collected by the Syunkotu-maru in May-June 1954. I. Chaetognatha. Ibid., Vol. IV, Nos. 2–3, pp. 219–225.



⊙ 1939
O 1938
△ 1937
⊕ 1934
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RUSSIA
TISIMA
JAPAN
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Fig. 1. Chart showing stations in the surveyed area.

Table 2. Detail of the occurrence of chaetognaths at respective stations.

	1. Okhotsk sea		2. More northern waters than 40°N.													3. Waters off the north-eastern Honsyû, south to 40°N.						
	57 (1937)	68 (1937)	46 (1938)	43 (1938)	40 (1937)	37 (1938)	60 (1938)	71 (1937)	26 (1939)	21 (1939)	17 (1934)	15 (1934)	13 (1934)	13 (1937)	13 (1938)	11 (1934)	77 (1938)	77 (1939)	78 (1937)	9 (1938)	6 (1934)	5 (1938)
1. *Sag. hexaptera*																6				12		1
2. *Sag. enflata*										1				16		7		3	238	30		32
3. *Sag. elegans*	24	189	424	356	210	28	2	182			14											1
4. *Sag. bipunctata*									2											1		2
5. *Sag. bedoti*									1	150		9	33	82	9	368	525	98	489	19	1	40
6. *Sag. pulchra*																			2			
7. *Sag. ferox*																				35		24
8. *Sag. robusta*															1	4			2	3		6
9. *Sag. serratodentata pacifica*																7				24		40
10. *Sag. serratodentata atlantica* f. *pseudoserratodentata*																						
11. *Sag. neglecta*																			3			
12. *Sag. regularis*																						
13. *Sag. crassa*																						2
14. *Sag. minima*																			1			
15. *Sag. decipiens*																						
16. *Pterosag. draco*																						
17. *Ktta. pacifica*																						
18. Damaged individuals or juv.																						3
Total	24	189	424	356	210	28	2	182	3	151	14	9	33	98	10	392	525	101	735	124	1	151

Table 2. (Continued.)

	4. Waters off the south-western Honsyû													5. Sagami Bay					
	N (1934)	2 (1938)	5 (1939)	7 (1938)	18 (1939)	23 (1938)	10 (1939)	29 (1938)	21 (1939)	47 (1938)	48 (1938)	25 (1939)	72 (1938)	(1934)	F2 (1934 Dec. 13)	(1934 Dec. 13)	A	B	C
1. *Sag. hexaptera*	1			6				1	7	1				2				3	1
2. *Sag. enflata*	33	6	2	12	6		7		3	5	9	2	17	28	64	5	8	9	6
3. *Sag. elegans*																			
4. *Sag. bipunctata*	2	23	20		5		2		4		5	30	20	5					
5. *Sag. bedoti*	3	432	1	13	41	1	65	1	6		2	2	1	17	143	3	6	6	31
6. *Sag. pulchra*																			
7. *Sag. ferox*	3	39	10	1	1		4				2	3	2	8			1	1	1
8. *Sag. robusta*	3	32	9	4	1	1		1	2			3	2	28	6				5
9. *Sag. serratodentata pacifica*				4			1				9		7	28	59			3	9
10. *Sag. serratodentata atlantica* f. *pseudoserratodentata*																	3		2
11. *Sag. neglecta*																			
12. *Sag. regularis*	2			1													2	1	
13. *Sag. crassa*		2		1										1	2			? 2	
14. *Sag. minima*																			1
15. *Sag. decipiens*																		2	
16. *Pterosag. draco*			1	2										2			3	3	3
17. *Ktta. pacifica*													2						
18. Damaged individuals or juv.		3						2						7	1		2	2	
Total	47	537	43	44	54	2	79	5	22	6	27	40	51	126	275	8	25	32	59

Table 2. (Continued.)

	6. Southern waters off Kyûsyû						7. East China Sea (1939)				8. Taiwan Straits (1939)		9. South China Sea (1939)								
	30 (1939)	103 (1938)	98 (1938)	84 (1938)	95 (1938)	52 (1938)	35	40	120	125	50	55	59	65	70	75	80	84	88	92	95
1. *Sag. hexaptera*	4			1	10						1									? 1	
2. *Sag. enflata*	21	49	5	9	19	2	18	6	20		30	158	46	3	12	256	153	39	1	7	4
3. *Sag. elegans*																					
4. *Sag. bipunctata*		5		4		58						1			4						
5. *Sag. bedoti*	2	37	16		1		1	137			74	58	241	4	36			1		2	1
6. *Sag. pulchra*	1																				
7. *Sag. ferox*	1	9	1		6	1	2		8	30	12	1	1	1	22					2	64
8. *Sag. robusta*	6	2	6	9	11	7					6	45	1	3	103	53	3	89	16	63	14
9. *Sag. serratodentata pacifica*	5	3	14	19		5			12	13		6	1		23						1
10. *Sag. serratodentata atlantica* f. *pseudoserratodentata*																					
11. *Sag. neglecta*									8	87	2			1		4	42		24		
12. *Sag. regularis*											1	1	1								
13. *Sag. crassa*			3					1			10		8			? 1					
14. *Sag. minima*																					
15. *Sag. decipiens*																					
16. *Pterosag. draco*											1	1									
17. *Ktta. pacifica*									16	7									1	1	
18. Damaged individuals or juv.		1										1						1			
Total	40	106	45	42	47	73	21	144	64	137	137	272	299	12	200	314	198	130	42	76	84

THE ALCYONARIAN GENUS *BELLONELLA* FROM JAPAN, WITH DESCRIPTIONS OF TWO NEW SPECIES[1]

HUZIO UTINOMI

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With Plates IX–X and 8 Text-figures

The genus *Bellonella*, better known as *Nidalia*, is more commonly represented in the Japanese Alcyonarian fauna than elsewhere in the world, probably comprising about half of all the known species referable to the genus. Among Japanese zoologists it is generally called "Umi-itigo" which means the sea strawberry in Japanese, but not so familiar as in shallow-water alcyoniids, since it has been occasionally collected by dredging or trawling nets of fishermen from the depths of about 20–600 meters. Although never actually on shores, most of the species living in aquaria are vividly colored fascinating to anyone looked on for the first time.

The hitherto most comprehensive studies on this genus were published by KÜKENTHAL (1906a, b) who enumerated seven species from Japanese waters, all referring to the genus *Nidalia* in his belief that *Bellonella* GRAY (1862) is synonymous with *Nidalia* GRAY (1835). Further, NUTTING (1921) added two new species from the "Albatross" Expedition, one referring to *Nidalia* (*N. gracilis*), while the other to *Bellonella* (*B. flava*). Accordingly, about nine valid species are at present known from Japanese waters.

As to the validity of the genus *Bellonella*, I will discuss in detail in another paper (UTINOMI, MS.), with a revision of the related genera, since it seems that the genus *Nidalia* (Type species: *N. occidentalis* GRAY) is to be regarded as a member of the family Siphonogorgiidae in the sense of generally accepted classification.

The present paper was intended to describe in detail all the known and two hitherto undescribed species from Japanese waters at present available for study and to clarify the evolutionary relationships between them. Among the species hitherto recorded, the seven species described by KÜKENTHAL have been rediscovered, but not the two described by NUTTING. In making the key to all the known species from Japan and even from the world, unfortunately, the existing descriptions often did not allow to identify them properly and to compare with one another. In this respect, NUTTING's descriptions of the two Japanese species are still incomplete, especially as

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[1] Contributions from the Seto Marine Biological Laboratory, No. 302.

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regards the anthocodial armature, thus leaving in suspense the status of both. I have accordingly postponed dealing with the regional species now not before me until these can be compared with the types of those described already by NUTTING.

In pursuing this work I am greatly indebted to many gentlemen of various institutions and universities who have collected or in care of specimens. Among them, my special thanks are due to Dr. H. HATTORI and staff members of the Biological Laboratory of the Imperial Household, and to Prof. D. MIYADI of the Zoological Institute of the Kyoto University. I am also indebted to the following for their kind cooperation for the loan or offer of pertinent specimens: Dr. I. TOMIYAMA, Marine Biological Station of Tokyo University, Misaki; Mr. M. IMAJIMA, Marine Biological Laboratory of Hokkaido Gakugei Daigaku, Sirigisinai; Miss S. OISHI, Fisheries Department, Prefectural University of Mie, Tu; Prof. T. KAMOHARA, Kochi University, Kochi; Mr. K. MORIKAWA, Ehime University, Matuyama; Mr. R. ISIBASI, Ozaki, Osaka Prefecture; Mr. M. OZAKI, Minabe, Wakayama Prefecture. All photographs in the plates were made by Mr. E. HARADA of our Laboratory.

The repositories of the specimens are abbreviated in text, unless otherwise specified, as follows:

I. B. L. —— Biological Laboratory of the Imperial Household, Tokyo.
Z. I. K. U. —— Zoological Institute, Kyoto University, Kyoto.
S. M. B. L. —— Seto Marine Biological Laboratory, Sirahama.

Key to the Japanese species of *Bellonella* here described

1. Calyces of low, 8-lobed, rounded verruca; anthocodial armature formed of many narrow spicules. 2
1. Calyces tubular in form; anthocodial armature formed of a few large spicules. ... 6
2. Colony plump, somewhat conical, slightly bent, with short sterile stalk. 3
2. Colony tall, cylindrical, with rather long sterile stalk relatively to total height of the colony. 4
3. Colony not flattened; coenenchyme with large and long spindles. ... *B. rubra* BRUNDIN
3. Colony flattened in one plane; coenenchyme with small and rather compact spindle. .... *B. grandiflora* (KÜKENTHAL)
4. Colony smaller than 6 cm long; stalk narrower than capitulum but similarly colored. .... *B. unicolor* (KÜKENTHAL)
4. Colony grown to large size; capitulum and stalk usually of the same diameter, but differentiated in coloration. 5
5. Capitulum deeper in coloration than stalk; calyces thickly set on capitulum; neck zone devoid of spicules; calyx rind contains pink spinose spindles with branched warts. .... *B. rigida* PÜTTER
5. Capitulum deeper in coloration than stalk; calyces widely separated; neck devoid of spicules; calyx rind contains reddish, very small spindles, toge-

ther with much longer, simply warted, colorless spindles under the superficial layer. .... *B. pellucida* (KÜKENTHAL)

5. Capitulum paler in coloration than stalk; calyces slightly separated (about 2 mm apart); polyps wholly devoid of spicules; all rind contains 8-radiate capstans with large round warts, while coenenchyme contains smaller capstans with stellate heads. .... *B. albiflora* n. sp.

6. Outer surface armed with small spindles, rather irregularly arranged; coenenchyme contains spindles similar to those of cortex; colony often branched, with variable coloration; calyces widely separated.... *B. dofleini* (KÜKENTHAL)

6. Outer surface thickly armed with large spindles longitudinally arranged; coenenchyme almost lacking spicules; colony unbranched. 7

7. Cortical spicules 4–6 mm long; calyces widely separated; colony orangish yellow. .... *B. macrospina* (KÜKENTHAL)

7. Cortical spicules 2–3 mm long; calyces imbricated longitudinally; colony brownish white. .... *B. sibogae* n. sp.

Description of the Species

1. *Bellonella rubra* BRUNDIN, 1896

(Pl. IX, figs. 1–2 and Text-fig. 1)

Bellonella rubra BRUNDIN, 1896, p. 6, Pl. I. fig. 2 & Pl. II, fig. 2.—(Korea Strait; Tugaru Strait[1])

Bellonella rubra PÜTTER, 1900, p. 447.—(No new record)

Nidalia rubra KÜKENTHAL, 1906a, p. 32; KÜKENTHAL, 1906b, p. 22, Pl. I, fig. 5 & Pl. V, figs. 29–30 —(Misaki, Sagami Bay)

Nidalia rubra NUTTING, 1921, p. 21.—(*Albatross* Sta. 4807, Cape Tsiuka, Bering Sea; *Albatross* Sta. 4815, Niigata Light, Sea of Japan)

? *Bellonella cinerea* BRUNDIN, 1896, p. 8, Pl. I, fig. 3 & Pl. II, fig. 3.—(Hirado Strait[2], northwest of Kyusyu)

? *Bellonella rubra* J. S. THOMSON, 1910, p. 554, Pl. II, fig. 13, Pl. III, fig. 21 & Pl. IV, fig. 43.—(South Africa, without exact locality)

? *Nidalia rubra* THOMSON and DEAN, 1931, p. 35, Pl. XXIII, fig. 6.—(*Siboga* Sta. 289, near Timor Island)

Japanese Name. Umi-itigo.

Material examined. Sagami Bay: 1) Ebine, off Nagai, 12 fms. June 16, 1956. 1 ex., 3 cm long (I.B.L. No. Coel. 570). 2) Samezima, at Hayama, depth unrecorded. Feb. 18, —. 4 ex., 2 cm, 2.6 cm, 3.6 cm and 4 cm long respectively (I.B.L. No. Coel. 46). 3) Samezima, at Hayama, depth unrecorded. July 6, 1929. 4 ex., 3.3 cm, 3.3 cm, 3.5 cm and 4 cm long respectively (I.B.L. No. Coel. 51).

Seto Inland Sea: 4) Gogosima, Ehime Prefecture, depth unrecorded. 1916. 1 ex., 7.5 cm long (Z.I.K.U.). 5) Southeast of Yasirozima, Yamaguti Prefecture. Aug. 6, 1939,

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[1] Originally misspelt as "Tsugar-Strasse".

[2] Originally misspelt as "Hirudo-Strasse".

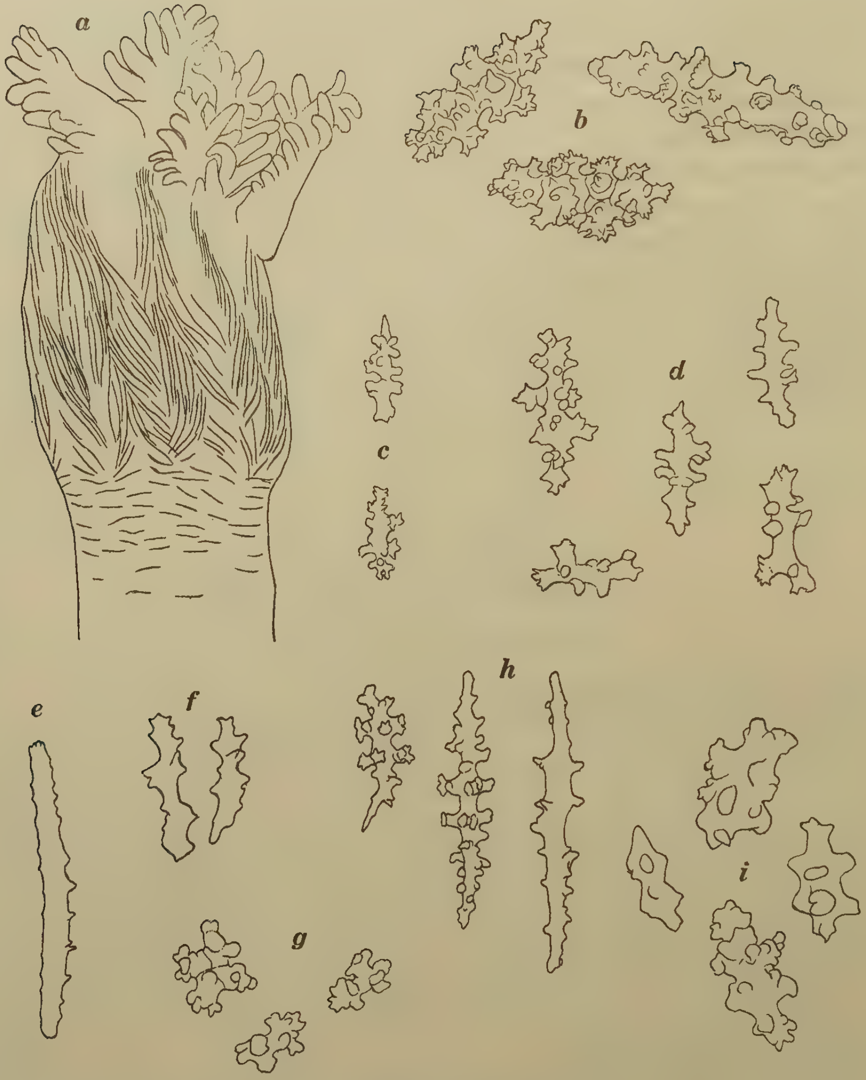


Fig. 1. *Bellonella rubra* BRUNDIN.

a–b, from a specimen from Sagami Bay (No. 570, I.B.L.).
c–d, from a specimen from off Yasirozima, Seto Inland Sea (E.U.).
e–i, from a specimen from Gogosima, Seto Inland Sea (K.U.).

a, Upper part of polyp; *b*, spicules from calyx wall; *c*, from calyx wall; *d*, from coenenchyme of stem; *e*, from anthocodia; *f*, from tentacles; *g*, from calyx wall; *h*, from coenenchyme of stem; *i*, from stalk cortex.

[*a*, ×27; *b–i*, ×150]

K. Morikawa coll. 1 ex., 6 cm long (Biological Institute, Ehime University).

Description. The colonies, represented by 11 specimens, are rather conical in form, slightly bent, ranging from 2 to 7.5 cm high and rigid in texture. In all of them, the stalk is invariably short but its length varies greatly, being from about 1/15 to 1/3 of the total height, when contracted. Sometimes it is only feebly developed, but always the calyces encircling the base of the capitulum extend downwards, forming more or less distinct longitudinal ridges.

When the polyps retracted, the calyces are thickly set and regularly arranged with the intervals of about 2 mm. These are low verruca, about 1.5–2 mm in diameter and distinctly 8-lobed at the top. Between the calyces an athecate hydroid *Hydrichthella epigorgia* Stechow often occurs densely, as in *B. rigida.*

The polyps, when extended, reach about 5 mm in length. Tentacles are about 1 mm long and bear 7–8 finger-like pinnules on each side, and a double row of about 0.12 mm long, flattened spiny rods arranged rather transversely on the back. The anthocodial armature consists of 8 double rows of steeply converging numerous spindles which are all slender in size, 0.19–0.38 mm long, 0.017–0.023 mm wide, feebly warted and bluntly ended. Below these the spicules are transversely arranged, not in the form of well-differentiated collaret, becoming sparsely into the eight interseptal tracts of the neck zone down to the calycular margin.

The calycular spicules are typical spindles covered by large compact warts, often forming transverse belts. In a specimen from Sagami Bay (I. B. L. No. 570), they measure 0.08×0.05 mm, 0.14×0.07 mm and 0.17×0.05 mm. In the stalk cortex, the spicules are similar in form, but their warts are not so compact but roundly obliterated, measuring 0.12×0.05 mm and 0.14×0.05 mm. The interior of the stem is densely filled with similar but longer, more slender spindles with widely separated high warts, usually pointed at both ends, rarely at one end alone. They measure 0.14×0.05 mm, 0.22×0.05 mm and 0.27×0.05 mm.

Color. The colony is uniformly deep carmin red, the capitulum and stalk being similar in color. All spicules are red.

Remarks. *B. cinerea* Brundin having colorless spicules was merged by Kükenthal (1906) into *B. rubra* on account of the inreliability of color in specimens preserved in alcohol. However, it is very problematic that the original color of spicules is retained for a long time in one specimen, while it may have been discolored in other specimens, even if they were simultaneosly preserved. Actually Thomson and Dean (1931) referred two small specimens with colorless or dull yellowish gray spicules among the "Siboga" collections to *B. rubra* "with some hesitancy". The spicules of "Siboga" specimens figured by them (cf. Pl. XXIII, fig. 6) do not exactly agree with those of *B. rubra* or *B. cinerea* in the slenderness and small size. It is probably not the same as either of both Japanese species.

The same may be said for the South African specimens of "*Bellonella rubra*" described and figured by J. S. Thomson (1910). The spicules more approach those of *B. rubra* than the above-cited East Indian specimens show. However, he states that "When contracted, the polyps appear as yellowish and reddish circular areas (calyces) on the surface of the deep red coenenchyma." and further "None of the polyps were in a completely expanded condition." Such conditions are by no means observed in our Japanese specimens. However, without reference to type material of both specimens, this is another question that must go unanswered.

2. *Bellonella grandiflora* (KÜKENTHAL), 1906

(Pl. IX, figs. 5–6 and Text-fig. 2)

Nidalia grandiflora KÜKENTHAL, 1906a, p. 34; KÜKENTHAL, 1906b, p. 24, Pl. I, figs. 6–7.—(Misaki, Sagami Bay)

Japanese Name. Ôbana-umiitigo.

Material examined. Sagami Bay: 1) Misaki. Nov. 1919, the late Prof. Iwaji IKEDA coll. 4 ex. (Z.I.K.U.). 2) Kasazima, shallow water. Apr. 17, 1949. 1 ex. (I.B.L. No. Coel. 298).

Description. All the specimens are very large, plump, club-shaped in form, distinctly curved to one side and strongly flattened in one plane. The basal sterile stalk is short and narrower than the expanded capitulum. The measurements of colonies in mm are as follows:

	Misaki	"	"	"	Kasazima
Total height	52	86	102	103	90
Length of stalk	8	18	10	25	10
Width of capitulum	30	24	30	35	53
Thickness of capitulum	23	19	26	27	45

The coloration and spiculation, as originally described, resemble closely those of *B. rubra*, but the polyps are extremely large, extending more than 1 cm in length and up to 2.5 mm in diameter of the head. The tentacles bear usually 7 pinnules on either side.

The anthocodial spicules are lengthwise arranged in 8 double rows, becoming downwards to be transversely set, smaller in size, paler in color and less densely distributed, so that the neck zone is transparent and appears colorless. The calyces are about 2.5–3 mm in diameter at the base and 1–2 mm high, and their walls contain typical spindles with simple or compact warts, about 0.07×0.035 mm, 0.11×0.04 mm and 0.13×0.04 mm. In the stalk cortex as well as in the coenenchyme are smaller spicules with few warts (less than 0.09 mm in length) which tend to be 8–radiates or capstans: besides, larger spindles not exceeding 0.18 mm in length with high warts are also contained.

Color. The colony is uniformly deep carmin red, but the polyps are transparent white in the neck zone due to the sparseness of red spicules.

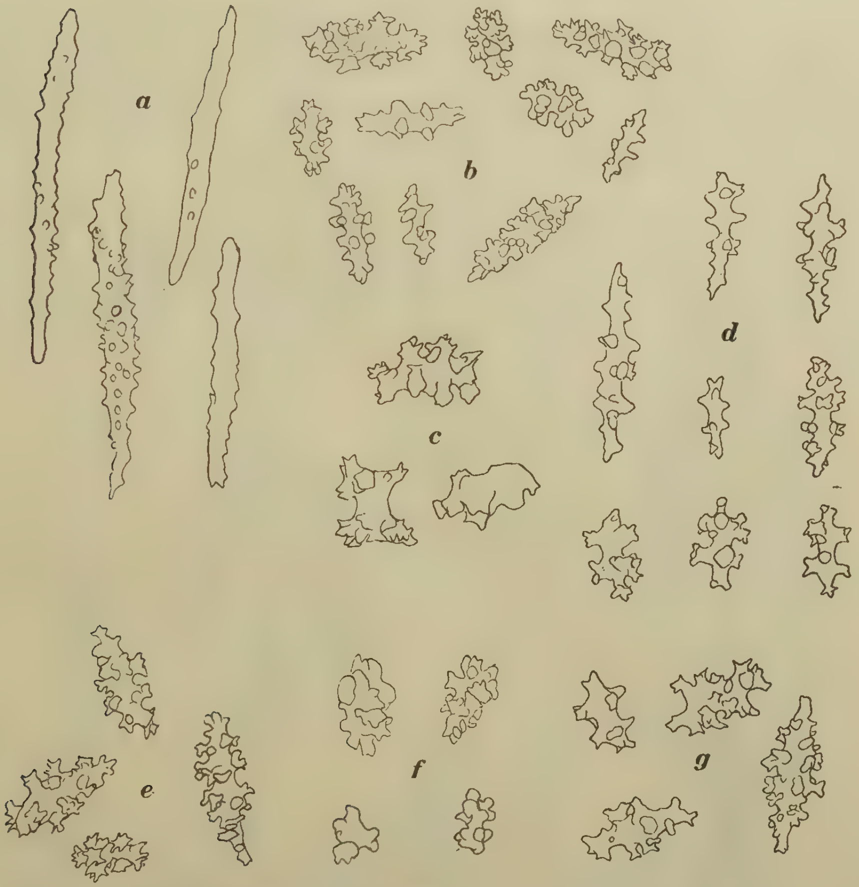


Fig. 2. *Bellonella grandiflora* (Kükenthal) from Misaki, Sagami Bay (Z.I.K.U.).
a–d, from a large specimen, 103 mm in total height.
e–g, from a small specimen, 52 mm in total height.
a, Spicules from anthocodia; *b*, from calyx wall; *c*, from stalk cortex; *d*, from coenenchyme of stem; *e*, from calyx wall; *f*, from stalk cortex; *g*, from coenenchyme of stem.
[All figs. ×150]

3. *Bellonella unicolor* (Kükenthal), 1906

(Pl. IX, figs. 3–4 and Text-figs. 3–4)

Nidalia unicolor Kükenthal, 1906a, p. 34; Kükenthal, 1906b, p. 26, Pl. I, fig. 4.—(Hakodate, 73 m)

Japanese Name. Hime-umiitigo (nom. nov.).

Material examined. Tugaru Strait: 1) Off Siriyazaki, northernmost cape of Honsyu, 180 m. Feb. 14, 1956, M. Imajima coll. 1 ex. (Marine Biological Laboratory, Sirigisinai, Hokkaido).

Sagami Bay: 2) Misaki. Date unlabelled. 1 ex. (Z.I.K.U.). 3) West of Kamegisyô, 52-54 m. Feb. 10, 1957. 1 ex. (I.B.L. No. Coel. 620). 4) West of Kamegisyô, 47–52 m. Feb. 10, 1957. 1 ex. (I.B.L. No. Coel. 623).

Description. The colonies are rather small for the genus, Indian club-like in form, with a shrunken stalk expanded at base. The consistency is rather rigid. The coloration is rather uniform as the name means, but variable in different colonies. The measurements (in mm) and coloration of all specimens here examined are shown as follows:

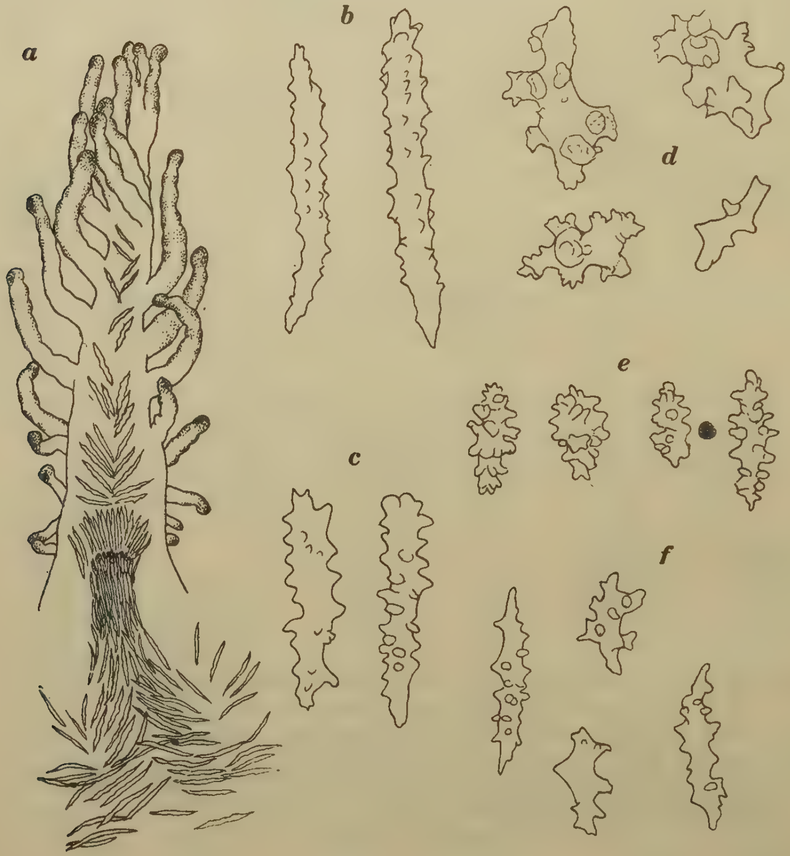


Fig. 3. *Bellonella unicolor* (KÜKENTHAL) from off Siriyazaki, Tugaru Strait. *a*, Tentacle, showing the arrangement of spicules, continued from the anthocodial point; *b*, spicules from anthocodia; *c*, from tentacles; *d*, from stalk cortex; *e*, from calyx wall; *f*, from coenenchyme of stalk. [*a*, ×33; *b*–*f*, ×150]

	Off Siriyazaki	Misaki	Kamegisyô (No. 620)	〃 (No. 623)
Total height	60	42	36	21
Length of stalk	20	15	10	10
Maximum diameter	12	8	7	9
Color	salmon pink	pinkish white	dark red	dark red

The capitulum is almost similar in size at the upper and lower levels and covered with polypal calyces, separated by intervals of about 2–3 mm. The calyces are relatively high, about 1–3 mm long, decreasing in size distally. The polyps extend about 3–4 mm beyond the calycular margin. The neck zone is devoid of spicules. In the

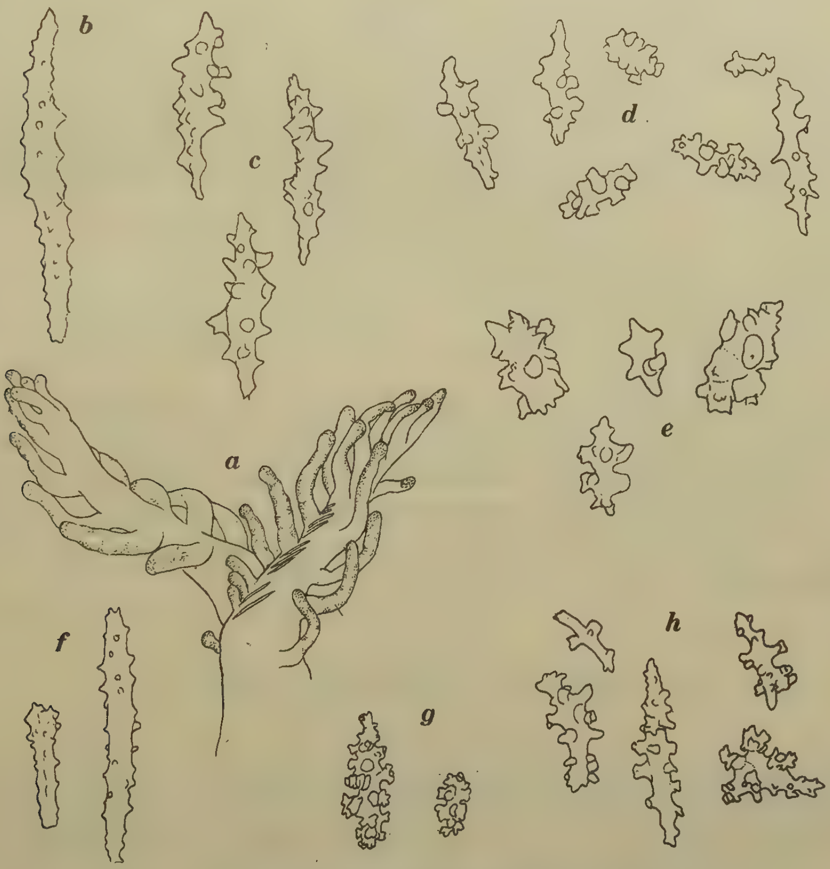


Fig. 4. *Bellonella unicolor* (KÜKENTHAL) from Sagami Bay.
a–e, from a specimen from west of Kamegisyô (No. 620, I.B.L.).
f–h, from a specimen from Misaki (Z.I.K.U.).
a, Two tentacles; *b,* spicules from anthocodia; *c,* from coenenchyme of stem; *d,* from calyx wall; *e,* from stalk cortex; *f,* from anthocodia; *g,* from calyx wall; *h,* from coenenchyme of capitulum.
[*a,* ×27; *b–h,* ×150]

anthocodial part, strongly warted spindles are arranged transversely, forming an indistinct collaret below, and then assume an *en chevron* arrangement, becoming parallel, converging and extending up to the tentacle bases, where they are ended distally in a somewhat fan-like manner. These spicules are about 0.26–0.35 mm in length and 0.03 mm wide, and those set in the distal part of points are often thickened at one end. The tentacles reach about 3 mm in length and bear on each side about 13, somewhat clavate, long pinnules. Along the tentacle backs for about two-thirds of their lengths, a few flattened warty rods, about 0.18 mm long and 0.03 mm wide, are arranged in a downwardly converging double row. The distal part of the tentacle and all pinnules are free of spicules.

The calyces over the capitulum contain small spindles with thickly set simple warts, measuring about 0.05–0.2 mm long and 0.035 mm wide. The stalk rind contains large, irregular-shaped spicules with large warts that appear to be derived from the spindle type. Their sizes largely exceed those of the calycular rind, as in the measurements: 0.09×0.05 mm, 0.1×0.05 mm, 0.12×0.07 mm and 0.26×0.09 mm. In the coenenchyme there are usually spiny spindles with conical warts, measuring about 0.14×0.07 mm, 0.17×0.05 mm, 0.26×0.05 mm and 0.35×0.05 mm.

Color. As stated above, the coloring of spicules is not constant within species. In the two specimens from Sagami Bay, the capitulum and stalk are uniformly dark red as in the type specimens, whereas in one from Misaki and one from off Siriyazaki (near the type locality) they are much paler. In any of them, the spicules of tentacles only are invariably colorless.

Remarks. The specimens described and figured by J. S. THOMSON (1910) from South Africa under the name "*Metalcyonium clavatum* PFEFFER" seem to be a nearest akin to this species, although he mentions that this is not a *Bellonella* or *Nidalia*. The difference between *Bellonella* and *Metalcyonium* many of which have been recorded from the Subantarctic region is so vague that only by a complete revision can their status be decided.

4. *Bellonella rigida* PÜTTER, 1900

(Pl. X, fig. 9)

Bellonella rigida PÜTTER, 1900, p. 448, Pl. XXIX, fig. 1.—(Nagasaki)
Eleutherobia japonica PÜTTER, 1900, p. 449, Pl. XXIX, figs. 2 & 11.—(Japan, without exact locality)
Nidalia rigida KÜKENTHAL, 1906a, p. 33; KÜKENTHAL, 1906b, p. 29.—(near Enosima, Sagami Bay; West of Formosa, 31 fms.)
Nidalia rigida UTINOMI, 1954, p. 43.—(Seto, 20–30 m; Kii Strait)

Japanese Name. Bô-umiitigo.

Material examined. Sagami Bay: 1) Off Hayama, taken by a Danish seine. Apr. 17, 1949. 1 ex., 9.8 cm long (I.B.L. No. Coel. 299). 2) Off Hayama, taken by a Danish seine. Mar. 24, 1951. 2 ex., 13 cm & 16 cm long (I.B.L. No. Coel. 368). 3) Off

Hayama, taken by a Danish seine. Apr. 24, 1951, 1 ex., 18 cm long (I.B.L. No. Coel. 372). 4) Off Hayama, taken by a Danish seine. Apr. 25, 1951. 2 ex., 10.5 cm & 18 cm long (I.B.L. No. Coel. 374). 5) Off Hayama, taken by a Danish seine. Jan. 14, 1957. 1 ex., 13 cm long, abnormally branched (I.B.L. No. Coel. 609).

Ise Bay: 6) Aritaki, Ise City. Aug. 24, 1950. 2 ex., 7 cm & 15 cm long (Fisheries Department, Prefectural University of Mie, Tu).

Kii Strait: 7) Off Minabe, 100–200 m. Mar. 1950, M. OZAKI coll. 1 ex., 7.8 cm long (S.M.B.L.).

Supplementary Description. This species was already described in detail on a specimen from Seto (UTINOMI, 1954), so that it might be needless to reiterate here. But some notes about these new materials are added as a supplement.

All of the specimens here examined are relatively large, being 7–18 cm in total height, like the types of this species (i.e. 72 mm for *Bellonella rigida* and 162 mm for *Eleutherobia japonica*, after PÜTTER). In most of the specimens, the base is not expanded but roundly ended with no hint of being attached to any solid substratum. The sterile stalk is relatively long, occupying about 1/6 to 1/3 of the total height, as shown in the following measurements (in mm):

	Off Hayama	”	”	”	Aritaki
Total height	98	130	160	180	150
Length of stalk	25	40	60	70	25
Maximum diameter	14	20	16	10	20

The consistency of the colony is rather rigid in smaller forms, while soft in larger forms. The calyces are scattered irregularly on all sides of the capitulum with intervals of about 2–3.5 mm, and the interspaces between them usually covered by an athecate hydroid *Hydrichthella epigorgia* forming a network of stolons.

Color. The capitulum and the basal parts of calyces, together with the polyp spicules, are bright red, while the tips of calyces are dirty white or yellowish. The stalk, especially in its basal half, is also dirty white.

5. *Bellonella pellucida* (KÜKENTHAL), 1906

(Pl. X, fig. 7 and Text-fig. 5)

Nidalia pellucida KÜKENTHAL, 1906a, p. 35; KÜKENTHAL, 1906b, p. 27, Pl. II, fig. 10.—(Sagami Bay, 50–100 m and between Ito and Hatusima)

Japanese Name. Ryûgû-umiitigo (nom. nov.).

Material examined. Sagami Bay: 1) Issiki, taken by a Danish seine. Feb. 22, 1930. 1 ex., 15 cm long (I.B.L. No. Coel. 28). 2) Misaki, depth and date unlabelled. 3 ex., 5.8 cm, 7.5 cm & 8 cm long respectively (Z.I.K.U.).

Description. The largest colony (No. 28), about 15 cm in length, is very flabby but not transparent. The stalk, arising from a membranous basal expansion, is transversely wrinkled, much shrunken, and its length is less than one-third of the total height. Namely, the capitulum is 115 mm and the stalk 30 mm in length, and about 15–17 mm in diameter of the capitulum.

The calyces are rather longitudinally arranged at long distances from one another

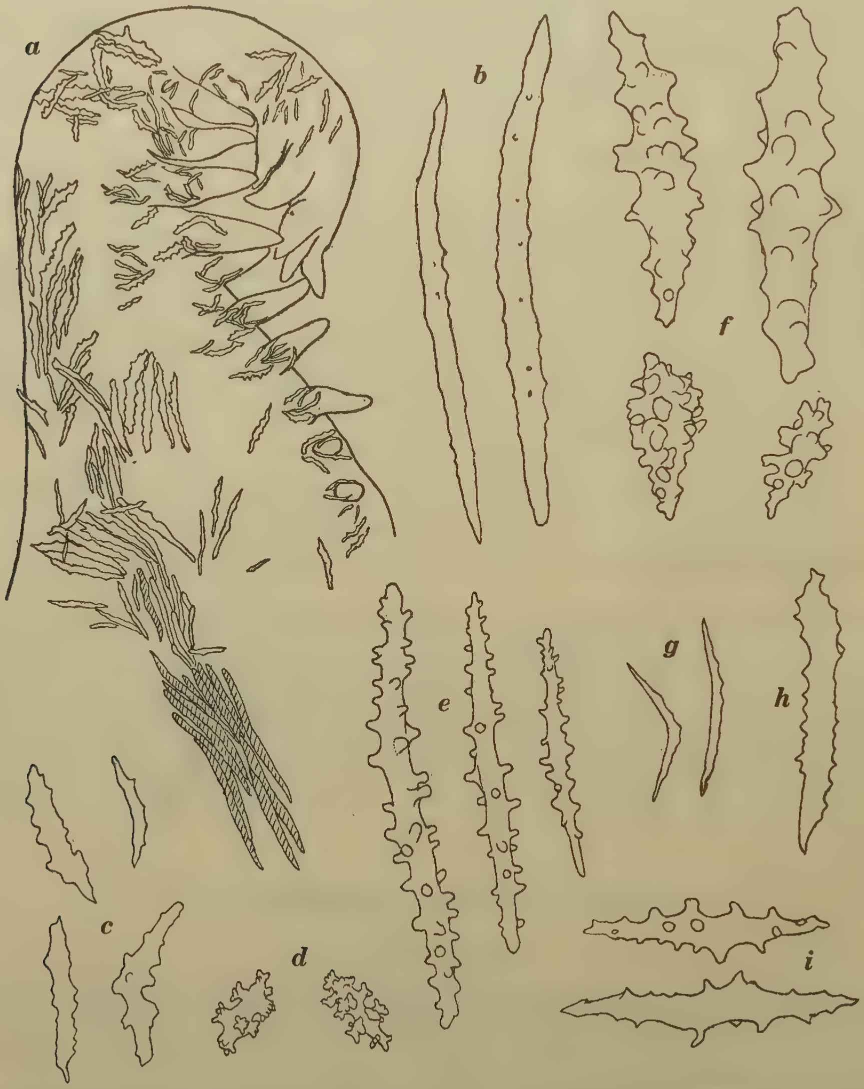


Fig. 5. *Bellonella pellucida* (KÜKENTHAL) from Issiki, Hayama, Sagami Bay (No. 28, I.B.L.).

a, Lateral view of tentacle, showing the arrangement of spicules (Red colored spicules being hatched, while colorless spicules not hatched); *b*, spicules from anthocodia; *c*, from stomodaeal wall; *d*, from outer layer of cortex, red in color; *e*, from inner layer of cortex, colorless; *f*, from stalk cortex; *g*, from bases of pinnules; *h*, from tentacles; *i*, from coenenchyme of capitulum.

[*a*, ×53; *b*–*i*, ×150]

(about 4 mm apart upwards, while about 6 mm apart downwards), being longitudinally grooved between them. They are about 1.5-2.0 mm across and relatively low in height. The polyps project considerably, extending about 10 mm beyond the tip of the calyces. They are wholly transparent owing to the total absence of spicules in the neck zone.

The anthocodial portion is, as usual, beset with the eight points of slender spindles arranged *en chevron* above the transverse collaret rows of shorter spindles. These anthocodial spicules are very feebly warted or almost smooth, brick red by reflected light and about 0.26–0.56 mm in length. They continue up to the longitudinal rows of colorless spicules along the tentacle backs. Thereafter the spicules are somewhat flattened and sharply pointed at both ends, about 0.26–0.35 mm long. In addition, a few bent needle-like spicules, about 0.09–0.12 mm long, surround the bases of the pinnules which number 13–14 on each side and are pointed distally. The stomodaeal wall is also provided with similar flattened spindles, about 0.1–0.16 mm long, transversely placed.

The spiculation of the cortex of the capitulum, as well as the calyces, is peculiar. The outer surface is covered with very small, red-colored, capstan-like spindle bearing compound warts, about 0.05×0.035 mm～0.07×0.05 mm in size; below these are densely distributed the much longer, colorless, slender spindles having high single warts, about 0.2×0.017 mm～0.4×0.035 mm in size. At the tips of the calyces, however, these spicules are closely mingled and not differentiated in coloration, thus the tip appears to be colorless.

In the cortex of the stalk too, there are two types of spindles. But here the spicules are larger, stouter and all colorless at all. They measure 0.26×0.07 mm and 0.35×0.05 mm in a large form, and 0.09×0.033 mm and 0.09×0.035 mm in a small form. In the coenenchyme, almost similar but weakly warted, colorless spindles are irregularly placed; they are 0.19×0.035 mm, 0.25×0.05 mm and 0.3×0.35 mm in measurements.

Color. As clear from the above description, the capitulum, together with the anthocodia, is brick red or bright red, while the stalk is dirty white at all. The tip of the calyces and the tentacles are colorless.

Remarks. Superficially this species is closely allied to the preceding *B. rigida*, but may be distinguished by its more distant arrangement of calyces and by the peculiar spiculation. Constrictions of the stem, if present, may depend upon the considerable softness of the constitution, and thus cannot be regarded as the diagnostic characteristics of this species.

6. *Bellonella albiflora* n. sp.

(Pl. X, fig. 8 and Text-fig. 6)

Japanese Name. Sirobana-umiitigo (nom. nov.).

Holotype. Sagami Bay: West of Kamegisyô, 45 m. Mar. 17, 1953. 1 ex. (I.B.L. No. Coel. 632).

Description. The single specimen is a very beautiful cylindrical colony, measuring ca. 90 mm in length and 12 mm in maximum diameter. The stalk is only 10 mm long, its basal portion being unfortunately damaged.

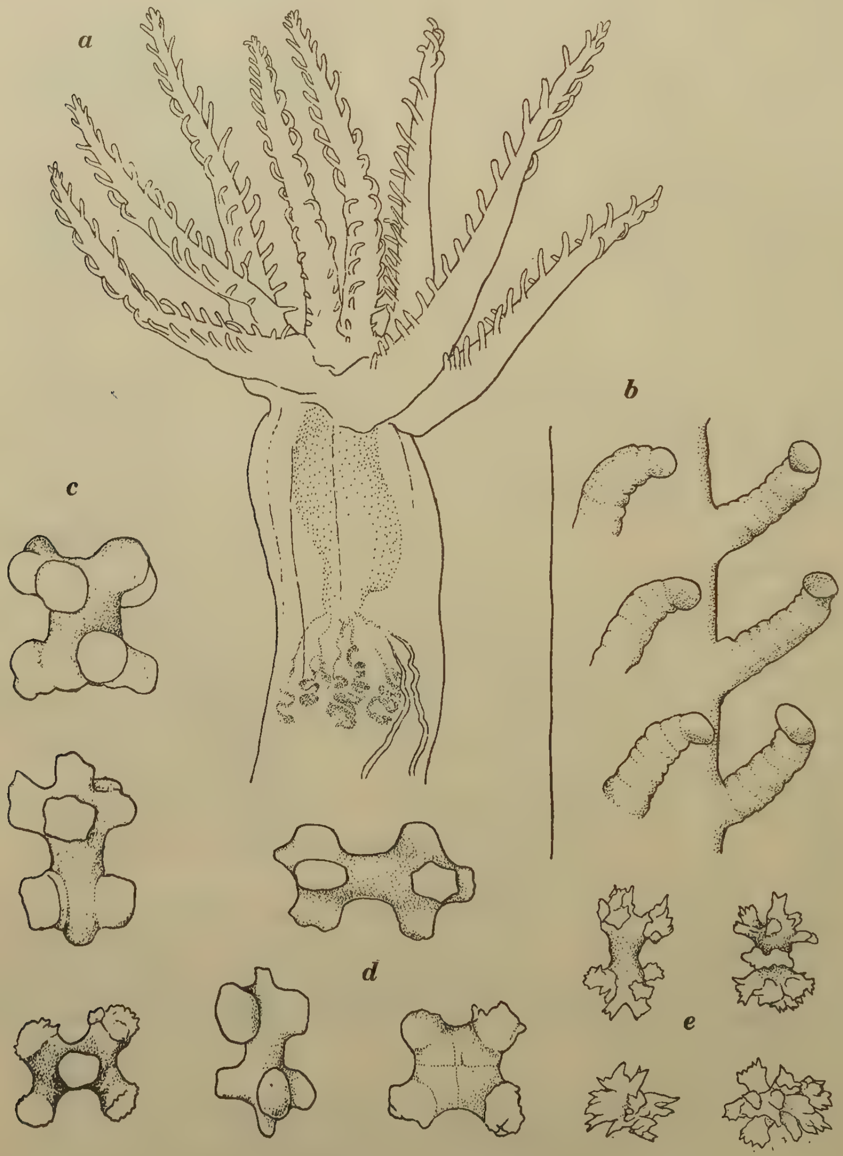


Fig. 6. *Bellonella albiflora* n. sp., holotype (I.B.L. No. 632).
a, Upper part of polyp; *b*, part of tentacle; *c*, spicules from stalk cortex (basal one in polar view); *d*, from calyx wall (right one at base is a cross); *e*, from coenenchyme.
[*a*, ×12; *b*, ×67; *c–e*, ×415]

All the polyps over the capitulum are fully extended beyond the slightly raised calyces which are irregularly distributed by intervals of about 1 mm. Each polyp is transparent and lacks spicules at all, reaching about 10 mm in length (excluding tentacles) and 2 mm in diameter. Tentacles, when fully extended, are very long up to about 5 mm and bear about 18 long pinnules equidistantly on each side. The pinnules are somewhat clavate in shape, terminating to a globose thickening; the longest one located in the middle measures about 0.3 mm long.

All the spicules present only in the stem are very small capstan types. In the stalk cortex, there are red 8-radiates with prominent large warts, measuring 0.05 × 0.038 mm, 0.056 × 0.033 mm and 0.056 × 0.038 mm. In the cortex of the capitulum are similar 8-radiates and crosses, but colored pale red, measuring 0.047 × 0.028 mm, 0.047 × 0.038 mm and 0.056 × 0.039 mm. In the interior of both portions are brick red capstans with star-like headed warts of smaller size, measuring 0.03 × 0.028 mm and 0.037 × 0.028 mm.

Color. The capitulum is pale pink or salmon pink, becoming darker towards the stalk where it is bright red. All polyps are transparent white.

Remarks. This very distinct species is unique for the genus in the occurrence of spicules of the capstan type and in the total absence of spicules in the polyps.

7. *Bellonella dofleini* (KÜKENTHAL), 1906

(Pl. X, fig. 12)

Nidalia dofleini, KÜKENTHAL, 1906a, p. 35; KÜKENTHAL, 1906b, p. 27, Pl. II, figs. 8-9.—(Misaki, 150 m)

Nidalia dofleini THOMSON and DEAN, 1931, p. 34, Pl. V, fig. 5 & Pl. XXV, fig. 5.—(*Siboga* Sta. 49a, 8°23.5′ S, 119°4.6′ E, 69 m); UTINOMI, 1954, p. 45, fig. 2.—(Off Minabe, Kii Strait, 100–200 m; Tosa Bay)

Japanese Name. Eda-umiitigo.

Material examined. Kii Strait: 1) Off Minabe, 100–200 m. Jan. 22, 1957, M. OZAKI coll. 2 ex. (S.M.B.L.).

Tosa Bay: 2) Off Mimase, 100–200 m. 1953, T. KAMOHARA coll. 27 ex., 18–50 mm long (S.M.B.L.).

Supplementary Description. This species is small, rather stiff, brittle, and often loosely branched. The calyces are rather sparsely distributed but mostly clustered at terminal ends of stem and branches. Each of them is rather high but wholly attached by its adcauline side to the surface of the stem, and the top is rounded and distinctly 8-lobed.

The spicules in the cortex and coenenchyme are predominantly small warty spindles tapering to one or both ends, less than 0.4 mm in length. In the cortex of the capitulum, the spicules are usually differentiated into two layers, though thickly set, shorter spindles about 0.05–0.15 mm long in the outer layer and longer ones about 0.09–0.37 mm long in the inner layer. In the stalk cortex, the spiculation is not so differentiated, containing more robust spindles with 4 warted girdles, about 0.1 0.17 mm long and 0.05×0.04 mm, 0.2×0.05 mm and 0.25×0.05 mm.

The anthocodial armature shows 6–7 pairs of curved, thorny spindles *en chevron* in eight points with about 7 transverse rows of thorny spindles below; they are about 0.44–0.6 mm long and 0.03 mm wide. The neck zone bears tiny rodlets, about 0.09 mm long, arranged transversely. The tentacle bears warty rods, about 0.1–0.2 mm long by 0.03 mm wide.

Color. The coloration varies greatly, being dirty white, pale yellow, pink, light orange or pinkish red, etc. The tips of the calyces are mostly paler, brighter or darker than the rest.

8. *Bellonella macrospina* (KÜKENTHAL), 1906

(Pl. X, fig. 10 and Text-fig. 7)

Nidalia macrospina KÜKENTHAL, 1906a, p. 34; KÜKENTHAL, 1906b, p. 30, Pl. II, figs. 11–12.—(Entrance to Tokyo Bay, 600 m)

Nec *Nidalia macrospina* THOMSON and DEAN, 1931, p. 35, Pl. VIII, fig. 7.

Japanese Name. Ôtoge-umiitigo (nom. nov.).

Material examined. Sagami Bay: 1) Kadone, Off Hayama, 100 m. Mar. 21, 1952. 2 ex., 4.2 cm and 5.4 cm in length, attached to a dead shell of *Glycymeris imperialis* KURODA respectively (I.B.L. No. Coel. 433; S.M.B.L.). 2) Kadone, off Hayama, 110 m. Feb. 2, 1956. 1 ex., 5 cm long (I.B.L. No. Coel. 540). 3) Syuragane, off Hayama, 120 m. Apr. 13, 1956. 1 ex., 4 cm long, on a pebble (I.B.L. No. Coel. 558).

Tosa Bay: 4) Off Mimase, 100–200 m. 1953, T. KAMOHARA coll. 2 ex., 4.2 cm & 4.5 cm long respectively (S.M.B.L.).

Description. The specimens are more or less slender, unbranched, erect colonies less than 5.4 cm in length, arising from a flattened basal expansion. Larger ones are somewhat plump in the lower portion, as shown in the following measurements of No. 433 from Sagami Bay, on which the following description of the spiculation is based. The sterile stalk is about 10 mm in length and 8 mm in diameter, while the polypiferous capitulum is about 44 mm in length and has a maximum diameter of 10 mm at its lowest part.

The calyces are arranged rather spirally around the capitulum, becoming sparse upwards and clustered at the terminal end. Each of them is tubular in form and projects obliquely upwards, adhering by its whole adcauline side to the stem. The top of the calyces is, when closed, not 8-lobed but truncated as in most Siphonogorgiids. Its diameter reaches about 2 mm at the top. Therefore, the calyces are placed from one another at wide intervals (about 6–8 mm) along the longitudinal axis.

In the cortex of the stem, together with the calyces, there are a number of large spicules lying longitudinally close together, so that the entire surface acquires a rigid brittle consistency. The spicules are exclusively long plump spindles covered by numerous small warts; they measure in the stalk about 3–5 mm in length and 0.3 mm in width, though shorter ones more numerous. In the calyx wall, they measure 0.8×0.09 mm, 1.5×0.12 mm and 2×0.8 mm. The interior of the stem is mostly devoid of spicules; but if present, they are almost smooth spindles, measuring 0.18×0.025 mm, 0.28×0.025 mm and 1.0×0.1 mm.

The polyps retracted into the calyces bear spicules in the anthocodial part and tentacles alone. The anthocodial armature consists of a distinct collaret of about 6 transverse rows of relatively large spindles and eight points each consisting of more

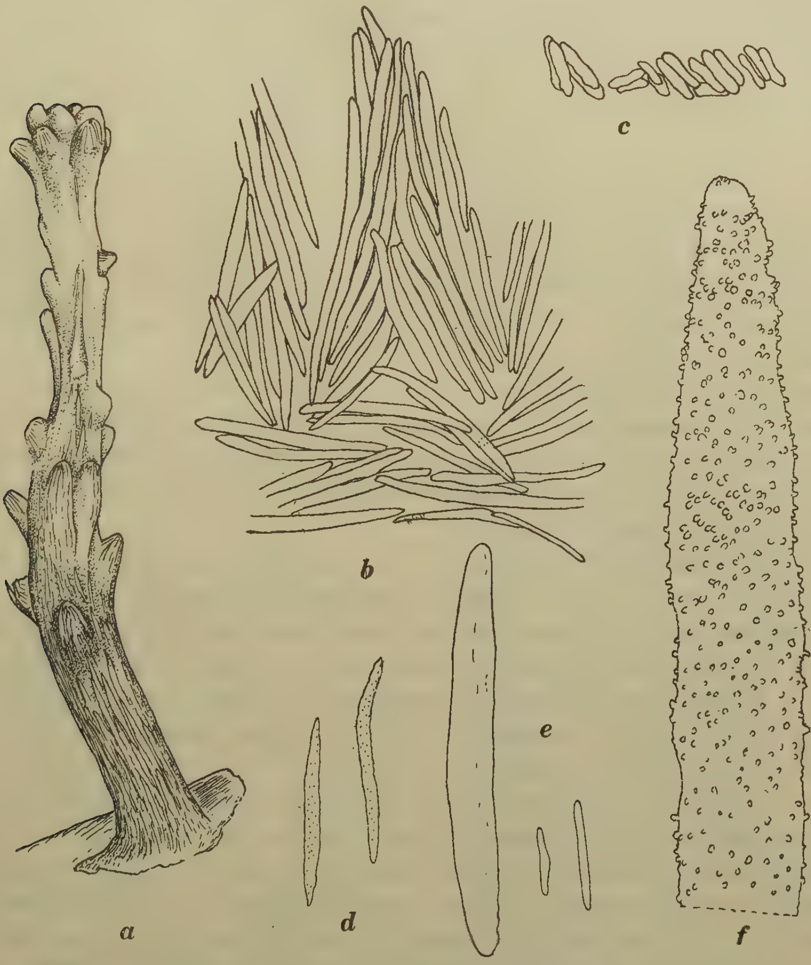


Fig. 7. *Bellonella macrospina* (KÜKENTHAL).
a, Specimen from off Hayama, Sagami Bay (No. 540, I.B.L.).
b–f, from specimen from off Nagai, Sagami Bay (No. 433, I.B.L.).
a, Animal; *b*, anthocodial armature; *c*, spicules from tentacles; *d*, from anthocodia; *e*, from coenenchyme; *f*, from stalk cortex (part).
[*a*, ×2; *b–c*, ×67; *d–f*, ×53]

than 7 pairs of similar spindles. These spindles are very finely warted and range between 0.26 × 0.26 mm ∼ 0.4 × 0.05 mm. The tentacles have flat rodlets, about 0.09 × 0.02 mm. The number of pinnules could not be counted.

Color. Pinkish cinnamon to apricot orange. Tip of calyces and anthocodiae are tinged with brighter orange, when the rest is yellowish in color.

Remarks. As already noticed by Kükenthal (1906b) and Thomson and Simpson (1909), this species, as well as the next *B. sibogae* n. sp., bears a strong resemblance to a certain Siphonogorgiid in spiculation and in form of the colony. Indeed, slender colonies such as two taken from Tosa Bay, showing less than 5 mm in diameter, may be often misled as an unbranched *Siphonogorgia*-like colony.

9. *Bellonella sibogae* n. sp.

(Pl. X, fig. 11 and Text-fig. 8)

Nidalia macrospina Thomson and Dean, 1931, p. 35, Pl. VIII, fig. 7 (Nec Kükenthal, 1906). (*Siboga* Sta. 251, 5°28.4′ S, 132°0.2′ E, 204 m)

Japanese Name. Tosa-umiitigo (nom. nov.).

Holotype. Tosa Bay: Off Mimase, 100–200 m. 1953, T. Kamohara coll. 1 ex. (S.M.B.L. Type No. 166).

Description. A single specimen, 7 cm in height with a basal width of 7 mm, consists of for the most part the polypiferous capitulum, and the sterile stalk is very short, only 12 mm in length. It is unbranched, cylindrical and slightly curved, tapering gradually upwards. The consistency of the colony is more stiff and brittle than in the preceding *B. macrospina.*

The calyces are very large, stout, tubular in form, and heavily armoured with large spicules. These tubular calyces are arranged close together, somewhat spirally around the stem and their distal portions project freely beyond the stem proper as in many of branched Siphonogorgiids. The largest one, when isolated, is thus tubular, expanded towards the top, measuring about 7 mm in height and about 2.5 mm in diameter at the top. The distance between the tops of adjoining calyces is about 3–4 mm *in situ.*

The polyps were completely retracted into the calyces, thus the actual size as well as shape could not be examined. The anthocodial armature consists of a distinct collaret of about 3 transverse rows, and points formed by 3–4 pairs of large spindles *en chevron.* These spindles are finely warted and bluntly ended, measuring 0.45 × 0.05 mm, 0.5 × 0.035 mm and 0.9 × 0.08 mm. On the tentacle backs rather robust, not flattened, rods are densely placed; they are between 0.3 × 0.05 mm and 0.1 × 0.018 mm, decreasing distally in size. Towards the bases of pinnules a few feebly warted rodlets, about 0.03–0.05 mm long and 0.008 mm wide, are scattered.

Entire surface of the stem and calyces is covered with large, close-fitting, heavily warted spindles, measuring about 1 × 0.1 mm, 2 × 0.23 mm, 2.35 × 0.23 mm, 2.8 × 0.3 mm and 3×0.3 mm. The coenenchyme apparently lacks spicules at all.

Color. Light yellowish brown, becoming paler towards the tops of calyces. All spicules colorless.

Remarks. A specimen collected by the "Siboga" Expedition which was identified by THOMSON and DEAN (1931) as *Nidalia macrospina* KÜKENTHAL is beyond doubt referable to the present new species. So the above name is here proposed.

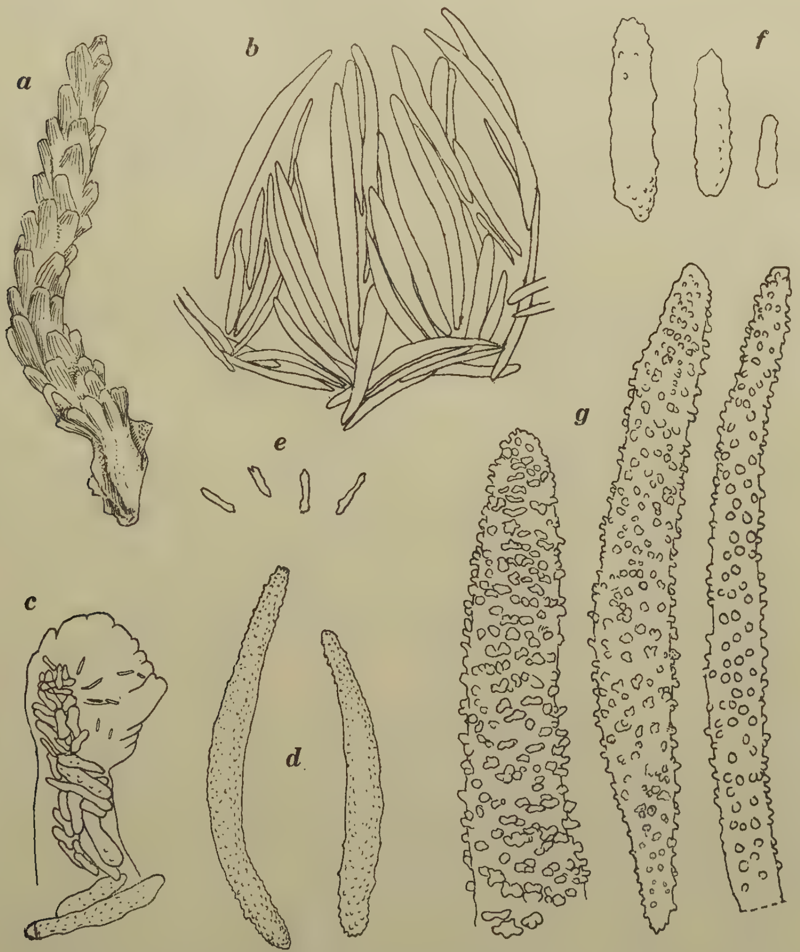


Fig. 8. *Bellonella sibogae* n. sp., holotype (Type No. 166, S.M.B.L.).

a, Holotype; *b*, anthocodial armature; *c*, tentacle showing the arrangement of spicules; *d*, spicules from anthocodial point; *e*, from pinnule bases; *f*, from tentacles; *g*, from stalk cortex and calyx wall.

[*a*, ×1; *b*-*c*, ×33; *g*, ×53; *e*-*f*, ×97]

A Note on the Evolution of Species Within the Genus

In describing the various species of *Bellonella* from Japanese waters and considering the relationships between them, I have arrived at the same conclusion as discussed by SHERRIFFS (1922) for the genus *Dendronephthya* (Nephtheidae) and also by CHALMERS (1929) for the genus *Siphonogorgia* (Siphonogorgiidae, or Nidaliidae as I will propose). The outstanding features which show the evolutionary relationship between the species within the genus and to other allied genera or groups are the retractility of the polyps, the anthocodial armature, the form of the anthosteles or calyces, and spicule types; in addition to these, the configuration of coenenchymes regarding the arrangement and abundance of spicules should be sometimes taken into account.

Within the Alcyoniidae, in most of the genera like *Alcyonium* and *Anthomastus* having large retractile polyps, the anthocodiae are heavily armoured, while in some aberrant (or specialized) forms the polyps only lack spicules completely. In this respect it is interesting to trace a transition between the species, suggesting an evolutionary trend within the genus *Bellonella*. The lengthwise *en chevron* arrangement of a large number of small spicules in the points as is often found in most Stoloniferans like *Clavularia*, is probably viewed as an indication of a primitive condition. Similarly, at their bases the spicules become to arrange more transversely, continuing down to the anthostele, often uninterruptedly in the retroversible neck zone, but in the most primitive condition they do not form any distinct crown or collaret rows (cf. Fig. 1, *a*). Further development of various modifications as representing evolutionary progression is probably shown by: (1) reduction of the number of spicules in the points, (2) formation of the distinct transverse rows in the collaret, (3) increasing in the size of all anthocodial spicules, and (4) reduction or elimination of spicules in the neck zone. In the systematic account given above, the species are arranged in order of the evolutionary trend.

Although such modifications are the universal tendency, the complete reduction of spicules in the polyps as in one example of the genus (*B. albiflora*) and in some aberrant forms of other Alcyoniids is probably a specialized feature and not indicative of more evolved forms in the main trend of evolution, that is another question that must be answered from different standpoint.

Mention must also be made of the structure of the non-retractile anthosteles and the main trunk of the colonies. In most of the species within the genus, like other Alcyoniids, the anthosteles forming the calyces into which the anthocodiae can be retracted are pronounced as a low mound, 8-lobed at the top, and thick-walled by virtue of dense spiculation. In more evolved forms such as *B. macrospina* (cf, Fig. 7, *a*) and *B. sibogae* (cf. Fig. 8, *a*), they develop to project freely as tubular forms and to be protected by a thick outer covering of larger spicules which continue from the cortical layer of the capitulum, and the tops of calyces appear to be rather truncated and not

8-lobed. In a peculiar form *B. dofleini* only (cf. UTINOMI, 1954, Fig. 2, *a b*), however, the calyces tend to become tubular, but retain certain primitive features, being 8-lobed at the top and less spiculated. In other respects, especially as regards the anthocodial armature, the polyps are rather highly specialized. This species presents thus an interesting transitional stage from the primitive forms having numerous small spicules in the anthocodiae to the evolved forms having smaller number of large spicules. Branching seems to have arisen independently for this genus.

In the more primitive forms of *Bellonella*, the trunk is soft and fleshy, and the coenenchyme is more or less filled with spicules. In the highly evolved forms, however, the trunk is rather stiff and brittle, and the coenenchyme contains very few or no spicules, in contrast with the outer thick wall closely packed with markedly large spicules, strongly recalling *Siphonogorgia*. These features seem to suggest that the *Siphonogorgia* and allied forms might have been derived from the Alcyoniidae of which the nearest one is *Bellonella*.

LITERATURE

BRUNDIN, J. A. F. 1896. Alcyonarien aus der Sammlung des zoologischen Museums in Uppsala. Bih. Till K. Sv. Vet.-Akad. Handl. 22 (4): 1-22, pls. 1-2. (Reprint)

CHALMERS, D. 1929. The Alcyonarian genus *Siphonogorgia*, with descriptions of new species. Proc. Phys. Soc. Edinb., 21: 159-169.

GRAY, J. E. 1835. Characters of a new genus of corals (*Nidalia*). Proc. Zool. Soc. London, 3: 59-60.

———— 1862. Description of two new genera of zoophytes (*Solenocaulon* and *Bellonella*) discovered on the north coast of Australia by Mr. Rayner. Ibid., 1862 : 34-37.

KÜKENTHAL, W. 1906a. Alcyonaria. Wiss. Ergeb. der Deut. Tiefsee-Exped., 13 (1): 1-111, pls. 1-12.

———— 1906b. Japanische Alcyonaceen. Abhandl. der K. Bayer. Akad. Wiss. II. Kl. Suppl. Bd. 1. Abt. (Beiträge zur Naturgeschichte Ostasiens): 1-86, pls. 1-5.

NUTTING, C. C. 1921. Descriptions of the Alcyonaria collected by the U. S. Fisheries steamer "Albatross" mainly in Japanese waters, during 1906. Proc. U. S. Nat. Mus., 43 (1923); 1-104, pls. 1-21.

PÜTTER, A. 1900. Alcyonaceen des Breslauer Museums. Zool. Jahrb. Abt. Syst., 13 (5): 443-462, pls. 29-30.

SHERRIFFS, W. R. 1922. Evolution within the genus *Dendronephthya* (*Spongodes*) (Alcyonaria), with descriptions of a number of species. Proc. Zool. Soc. London, 1922: 33-37, pls. 1-3.

THOMSON, J. A. and DEAN, L. M. I. 1931. The Alcyonaria of the Siboga Expedition, with an addendum to the Gorgonacea. Siboga-Exped., Monog. XIIId (Lief. 115): 1-227, pls. 1-28. Leiden.

———— and SIMPSON, J. J. 1909. Alcyonaria of the Investigator, II. The Alcyonaria of the littoral area. xii+319 pp., 9 pls. Calcutta.

THOMSON, J. S. 1910. The Alcyanaria of the Cape of Good Hope and Natal. Alcyonacea. Trans. Roy. Soc. Edinb., 47 (3): 549-589, pls. 1-4.

UTINOMI, H. 1954. Some Alcyoniid octocorals from Kii coast, middle Japan. Publ. Seto Mar. Biol. Lab., 4 (1): 43-55, pl. 1.

———— A revision of the genera *Nidalia* and *Bellonella* (Octocorallia, Alcyonacea). Bull. Brit. Mus. (Nat. Hist.), Zool. [In preparation.]

EXPLANATION OF PLATES IX–X

PLATE IX

Fig. 1. *Bellonella rubra* BRUNDIN, from southeast of Yasiro-zima, Seto Inland Sea.

Fig. 2. *Bellonella rubra* BRUNDIN, from Same-zima, Hayama in Sagami Bay (within I.B.L. No. Coel. 51).

Fig. 3. *Bellonella unicolor* (KÜKENTHAL), from west of Kamegisyô, Sagami Bay (I.B.L. No. Coel. 620).

Fig. 4. *Bellonella unicolor* (KÜKENTHAL), from off Siriyazaki, Tugaru Strait, 180 m.

Fig. 5. *Bellonella grandiflora* (KÜKENTHAL), from Misaki, Sagami Bay (Z.I.K.U.).

Fig. 6. Another specimen of *Bellonella grandiflora* (KÜKENTHAL), from Misaki, Sagami Bay (Z.I.K.U.).

PLATE X

Fig. 7. *Bellonella pellucida* (KÜKENTHAL), from off Issiki, Sagami Bay (I.B.L. No. Coel. 28).

Fig. 8. *Bellonella albiflora* n. sp., holotype, from west of Kamegisyô, Sagami Bay, 45 m (I.B.L. No. Coel. 632).

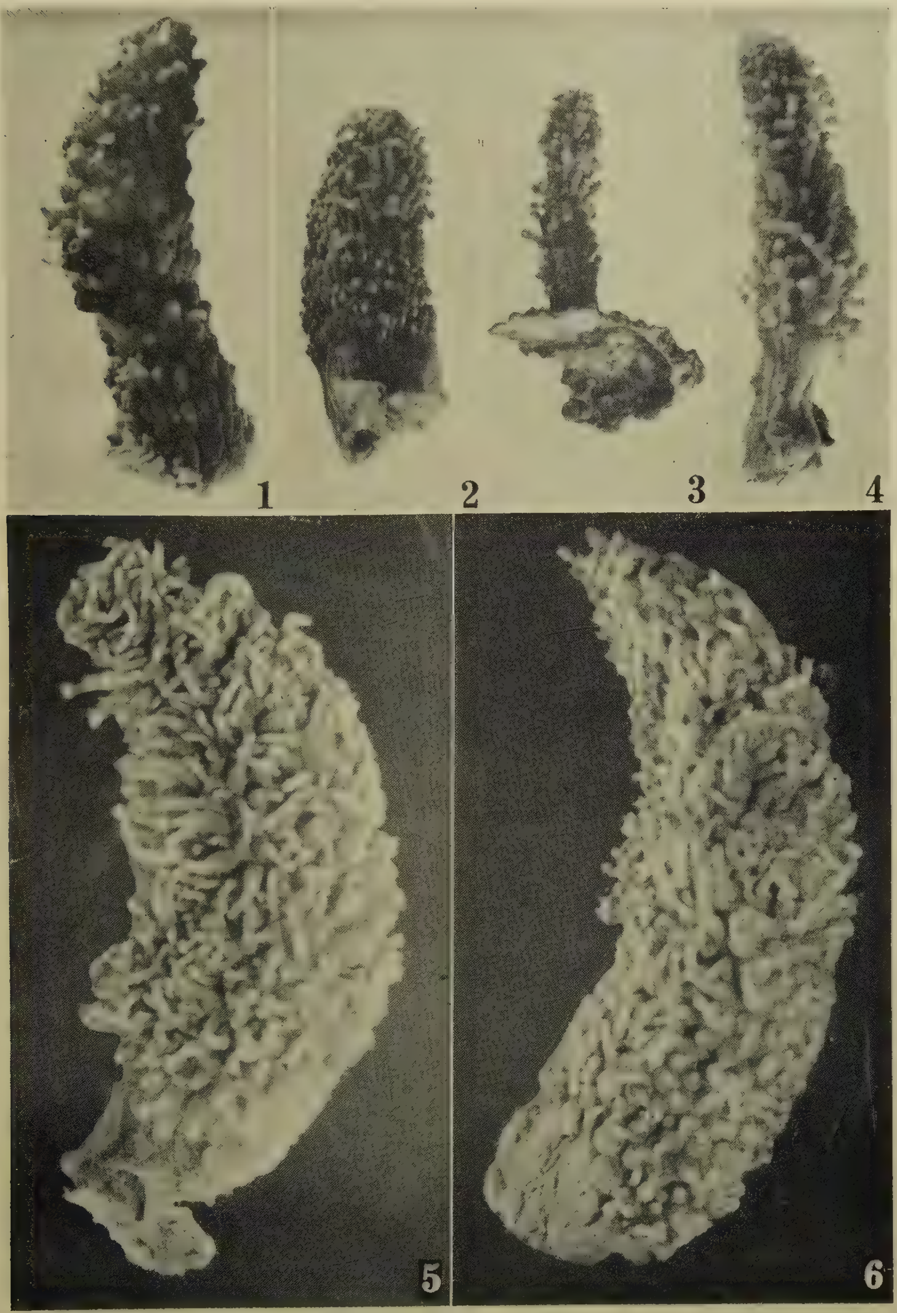
Fig. 9. *Bellonella rigida* PÜTTER, from off Hayama, Sagami Bay (I.B.L. No. Coel. 372).

Fig. 10. *Bellonella macrospina* (KÜKENTHAL), from Kadone, off Hayama, 100 m, attached to a shell of *Glycymeris imperialis* (I.B.L. No. Coel. 433).

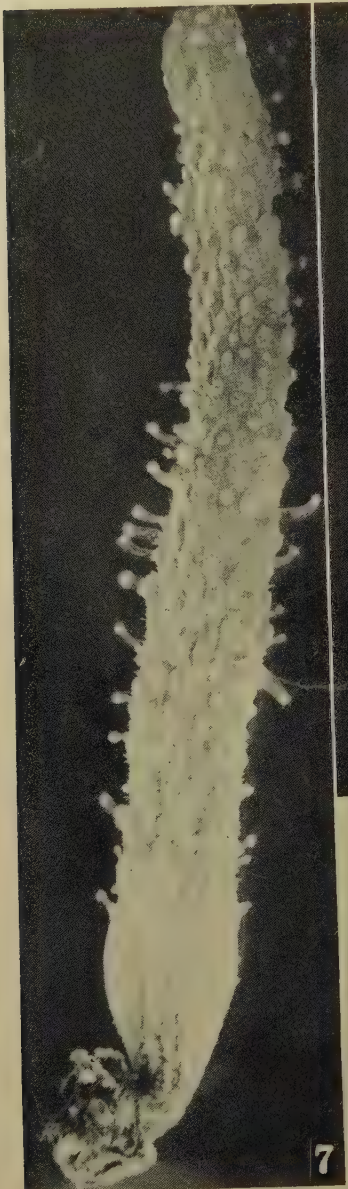
Fig. 11. *Bellonella sibogae* n. sp., holotype, from off Mimase, Tosa Bay, 100–200 m (S.M.B.L. Type No. 166).

Fig. 12. *Bellonella dofleini* (KÜKENTHAL), from off Mimase, Tosa Bay, 100-200 m Five branched and one unbranched specimens (S.M.B.L.).

(All photographs in both plates are of natural size.)



H. Utinomi: Alcyonarian Genus *Bellonella* from Japan.



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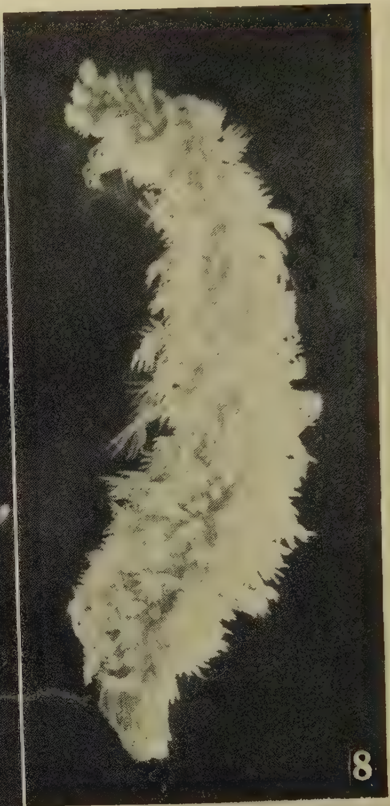

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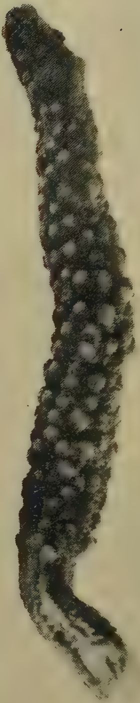

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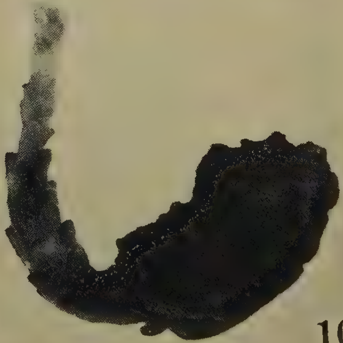

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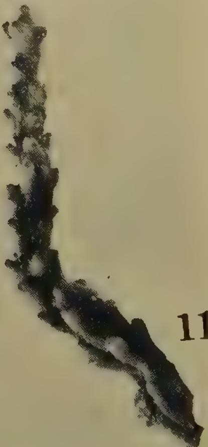

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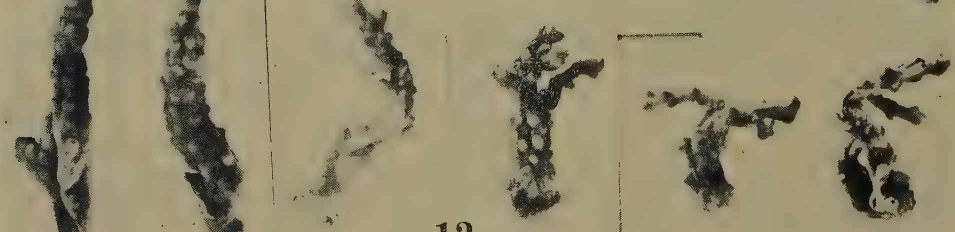

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H. Utinomi: Alcyonarian Genus *Bellonella* from Japan.

THE PELAGIC COPEPODS OF THE IZU REGION, MIDDLE JAPAN SYSTEMATIC ACCOUNT IV.

FAMILY AETIDEIDAE (PART 2)

Otohiko TANAKA

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With 21 Text-figures

Family AETIDEIDAE

Genus *Gaidiopsis* A. Scott, 1909

A. Scott created the genus *Gaidiopsis* to accomodate a single species, *Gaidiopsis crassirostris*, which differs from *Gaidius* in the followings: last two thoracic segments completely separate; exopodite of first leg 3–jointed; endopodite of second leg distinctly 2–jointed. I have, up to present, found no specimen belonging to the genus from the Izu region.

Genus *Gaetanus* Giesbrecht, 1888

Up to the present time two species of this genus have been recorded from the Japanese waters: they are *G. armiger* Giesbrecht and *G. minor* Farran. I have found three more species in the collection: *Gaetanus kruppi* Giesbrecht, *G. miles* Giesbrecht and *G. pileatus* Farran. The genus resembles *Gaidius* in general structure: head has a median spine; first antenna 24–jointed; second antenna with endopodite which is shorter than exopodite; mandible, maxillae and maxillipede as those of *Gaidius*; exopodite of first leg 2–jointed or sometimes 3–jointed; fourth leg with spines on inner margin of first basal joint; fifth leg absent in female; fifth pair of legs of male resemble those of *Gaidius*.

Gaetanus kruppi Giesbrecht

(Fig. 41, *a–g*)

Gaetanus kruppi Giesbrecht, 1904, p. 202; A. Scott, 1909, p. 48; With, 1915, p. 97; G. O. Sars, 1925, p. 61; Farran, 1926, p. 249; Sewell, 1929, p. 102; Wilson, 1932, p. 52; Jespersen, 1934, p. 62; Sewell, 1947, p. 62.

Publ. Seto Mar. Biol. Lab., VI (2), 1957. (Article 12)

Female. Length, 4.95 mm : cephalothorax, 3.95 mm ; abdomen, 1.00 mm. Cephalothorax rather slender, about 2.9-times as long as wide. Forehead with a median spine directing forwards and slightly downward (fig. *a*, *b*). Rostrum short. Lateral spines of last thoracic segment slightly divergent, reaching the middle of genital segment (fig. *c*).

Abdomen 4-segmented ; segments and furca with proportional lengths 42 : 17 : 12 : 12 : 17 = 100 ; furcal rami a little longer than wide.

First antenna 24-jointed, extends beyond distal end of abdomen by last three joints ; joints are in the proportional lengths :

Joint	1	2	3	4	5	6	7	8–9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
	56	34	16	19	25	25	28	47	22	25	28	53	50	56	53	56	53	65	59	50	65	56	40	19=1000 ;

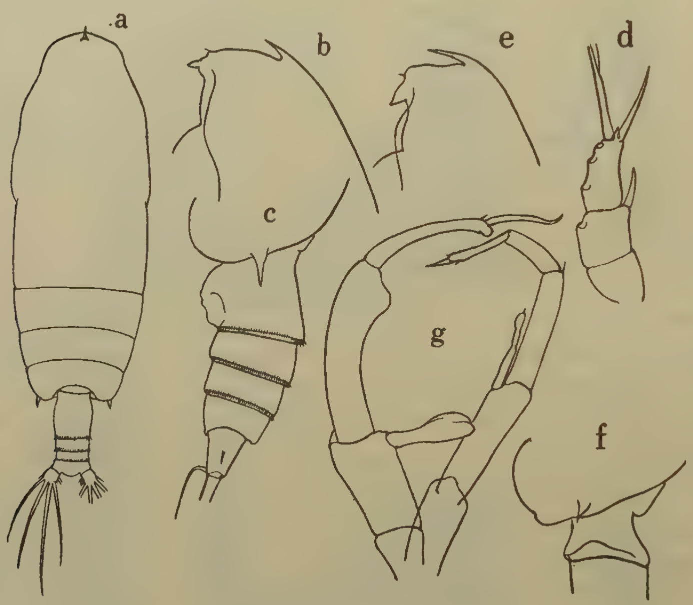

Fig. 41. *Gaetanus kruppi* GIESBRECHT.

a, Female : dorsal aspect ; *b*, head, lateral aspect ; *c*, last thoracic segment and abdomen, lateral aspect ; *d*, exopodite of first leg ; *e*, Male : head, lateral aspect ; *f*, last thoracic segment, lateral aspect ; *g*, fifth pair of legs.

WITH describes that joints 2, 8–9 and 20 are of about equal lengths, but in the present specimen the 20th is the longest. Second antenna with exopodite about 1.2-times as long as endopodite ; distal joint of endopodite bears 14 setae. Mandible has a small exopodite. First maxilla with 7+2 setae on outer lobe, 11 setae on exopodite, 4+4+7 setae on endopodite, 5 setae on second basal, 4 setae on third inner lobe, 4 setae on second inner lobe; third inner lobe has, beside 4 setae, a conical process. Second maxilla not characteristic. Maxillipede with a lamellous process on the middle of the anterior surface of first basal joint.

First leg with an articular membrane between first and second joints of exopodite (fig. *d*). Second leg has 20 teeth on terminal spine of exopodite; teeth are connected by a sort of lamella; endopodite 2-jointed. Third leg with 21 teeth on terminal spine of exopodite. Fourth leg has 14 stiff triangulary pointed marginal bristles on posterior surface of first basal joint.

Male. Length, 4.87 mm: cephalothorax, 3.75 mm; abdomen, 1.12 mm; the greatest width of cephalothorax, 1.38 mm. Cephalothorax more slender than that of the female. Cephalic spine slender and long (fig. *e*). Rostrum more clumsy. Lateral spines of last thoracic segment shorter (fig. *f*).

Abdomen 5-segmented; segments and furca with proportional lengths 20:28:22:15:3:12=100; furcal rami about as long as wide.

First antenna extends to the middle of third abdominal segment; the segmentation in 8th to 14th joints are, as stated by WITH, difficult to make out; joints are in the proportional lengths:

Joint	1	2	3	4	5	6	7	8–9	10	11	12	13	14	15	16	17
	55	32	20	20	24	28	32	52	16	28	26	24	24	55	55	60

	18	19	20–21	22	23	24–25
	60	72	120	75	72	60=1000.

Second antenna has exopodite about as long as endopodite; first joint of exopodite is furnished with hairs on the posterior margin; first joint of endopodite rather clumsy. Mandible has a broad second basal joint furnished with a single short seta; both exopodite and endopodite well developed; First maxilla slightly reduced; outer lobe has 7, long setae and 2 short ones; exopodite has 11 setae; endopodite has 5+2+2 setae; second basal joint has one long and 2 short setae. Second maxilla much reduced and soft-skinned. Maxillipede has no lamellous process on first basal as observed in the female; distal part of first basal joint is produced into a claw-like lamellous process.

In first leg, outer edge spine of second joint of exopodite is represented by a minute spinule. Terminal spine of exopodite of second leg has 29 to 34 teeth, that of third and fourth leg have each 28 and 30 teeth respectively. Fifth pair of legs as described by WITH, but the small process at base of third joint of exopodite of left leg was not observed in the present specimen (fig. *g*).

Occurrence. Six females and three males from Sagami, Nov. 1937, one female from Suruga, Dec. 1937, from 1000 to the surface.

Distribution. The species is widely distributed in the deep waters of the Atlantic, Pacific and Indian Oceans.

Gaetanus armiger Giesbrecht

(Fig. 42, *a–d*)

Gaetanus armiger Giesbrecht, 1892, p. 219; A. Scott, 1909, p. 45; Sars, 1925, p. 59; Sewell, 1929, p. 101; Mori, 1937, p. 40.

Female. Length, 3.37 mm: cephalothorax, 2.62 mm; abdomen, 0.75 mm. Cephalic spine slender and short, directing forwards (fig. *a*). Rostrum small; frontal prominence low (fig. *b*). Lateral spines of last thoracic segment divergent, and extend beyond the middle of genital segment. Articulation between fourth and fifth thoracic segments slightly visible in dorsal aspect (fig. *c*).

Abdomen 4–segmented; segments and furca with proportional lengths 52 : 22 : 19 : 15 : 22 = 100. Genital segment as long as wide. Furcal rami about 1.2–times as long as wide.

First antenna 23–jointed, extends to distal end of third abdominal segment; proportional lengths of the joints:

Joint	1	2	3	4	5	6	7	8–9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24–25
	54	37	20	20	23	25	28	45	28	28	28	48	48	51	51	54	54	65	57	51	62	57	68 = 1000;

joints 24–25 are 1.05–times as long as joint 19; according to Giesbrecht, joints 22 and 23 are of equal lengths, but in the present specimen joint 22 is 1.1–times as long as the 23rd. Second antenna with exopodite 1.2–times as long as endopodite. Maxillae as those of the preceding species. Maxillipede has no lamellous process on the distal margin of first basal joint.

Exopodite of first leg as shown in the figure (fig. *d*). Terminal spine of exopodite of second to fourth legs have 18, 18 and 27 teeth respectively; fourth leg bears 17 spines on inner margin of first basal joint at the base of inner marginal seta.

Occurrence. One adult female from Sagami, Nov. 1937, from 1000–0 m.

Distribution. The species has a wide distribution, and has been recorded from the Pacific, Atlantic, Indian Oceans, Malay Archipelago and the Gulf of Guinea.

Gaetanus minor Farran

(Fig. 42, *e–g*)

Gaetanus minor Farran, 1905, p. 34; Farran, 1908, p. 37; A. Scott, 1909, p. 47; Wolfenden, 1911, p. 233; With, 1915, p. 103; Sars, 1925, p. 60; Farran, 1926, p. 250; Sewell, 1929, p. 102; Jespersen, 1934, p. 62; Farran, 1936, p. 89; Tanaka, 1937, p. 257; Sewell, 1947, p. 59.

Length. Female, 2.23 mm: cephalothorax, 1.82 mm; abdomen, 0.41 mm. Lateral spines of last thoracic segment reach about the end of genital segment (fig. *e*, *f*).

Abdomen 4-segmented; segments and furca with proportional length 44:17:13:9:17=100; furcal rami as long as wide; genital segment a little wider than long.

First antenna 23-jointed, reaches back to distal end of third abdominal segment; joints are in proportional lengths:

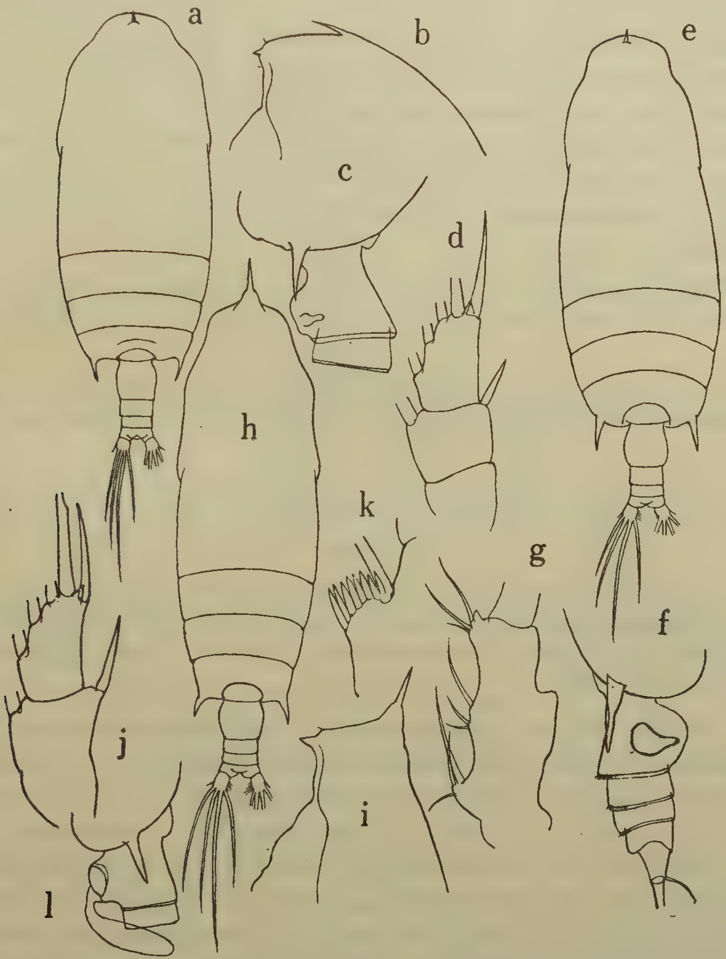

Fig. 42. *Gaetanus armiger* GIESBRECHT (*a-d*),
Gaetanus minor FARRAN (*e-g*),
Gaetanus miles GIESBRECHT (*h-l*).

a, *Gaetanus armiger*, Female: dorsal aspect; *b*, head, lateral aspect; *c*, last thoracic segment and genital segment, lateral aspect; *d*, exopodite of first leg; *e*, *Gaetanus minor*, Female: dorsal aspect; *f*, last thoracic segment and abdomen, lateral aspect; *g*, first basal joint of maxillipede; *h*, *Gaetanus miles*, Female: dorsal aspect; *i*, head, lateral aspect; *j*, exopodite of first leg; *k*, inner margin of first basal joint of fourth leg; *l*, last thoracic segment and genital segment, lateral aspect.

Joint	1	2	3	4	5	6	7	8–9	10	11	12	13	14	15	16	17
	58	40	26	22	26	26	31	40	22	26	26	40	44	44	49	53
	18	19	20	21	22	23	24–25									
	53	69	57	44	67	57	53 27=1000;									

joints 19 and 22 are of about equal lengths. Second antenna with exopodite about 1.2–times as long as endopodite. In 1st maxilla second inner lobe carries, as described by With, two strong setae and short spine-like setae. Maxillipede with a lamellous process on first basal joint about the middle of posterior margin (fig. *g*).

First leg with 2–jointed exopodite. The number of teeth on terminal spine of second to fourth legs are 13, 15 and 13 respectively.

Remarks. I have previously collected an immature female specimen in the fifth copepodid stage from Suruga in the vertical haul from 500–250 m; the specimen measured 2.00 mm.

Occurrence. Six adult females from Sagami in the vertical hauls 1000–0 m, Nov. 1937.

Distribution. The species has a wide distribution, and has been reported from the North Atlantic, Indian Seas, Malay Archipelago and Great Barrier Reef region.

Gaetanus miles Giesbrecht

(Fig. 42, *h–l*)

Gaetanus miles Giesbrecht, 1982, p. 219, t. 14, 36; Farran, 1908, p. 36; A. Scott, 1909, p. 44; Wolfenden, 1911, p. 231; With, 1915, p. 107; Sars, 1925, p. 54; Sewell, 1929, p. 102, Wilson, 1932, p. 51; Jespersen, 1934, p. 61; Farran, 1936, p. 89; Sewell, 1947, p. 58; Brodsky, 1950, p. 168.

Female. Length, 3.96 mm: cephalothorax, 3.25 mm; abdomen, 0.71 mm. Cephalic spine long. Rostrum short. Lateral spines of last thoracic segment divergent, and extend beyond the middle ef genital segment (fig. *h, i, l*).

Abdomen is contained 4.6–times in the length of cephalothorax; abdomen 4–segmented, segments and furca with proportional lengths 41 : 15 : 13 : 13 : 18 = 100; genital segment wider than long; furcal rami as long as wide.

First antenna 23–jointed, about 2.6–times as long as total length of body; distal 10 joints exceeds end of furca; joints are in the proportional lengths;

Joint	1	2	3	4	5	6	7	8–9	10	11	12	13	14	15	16	17
	20	19	12	12	16	18	21	42	25	30	32	46	48	58	62	67
	18	19	20	21	22	23	24–25									
	65	77	85	69	85	50	37=1000;									

according to Giesbrecht joints 8–9, 13 and 24–25 are of equal lengths, but in the present specimen they agree with the description given by With: joint 13 is 1.1–times as long as joints 8–9, and 1.2–times as long as joints 24–25. Second antenna with exopodite 1.2 times as long as endopodite. Outer lobe of first maxilla with 7+2 setae, endopodite with 11 setae, second inner lobe with 4 setae, third inner lobe with 4 setae and a small conical process. In maxillipede second basal joint 1.4-times as long as the first which is furnished with rounded lamellous process on the posterior margin.

In first leg outer edge spine of second joint of exopodite reaches almost the distal end of third joint of exopodite. Second leg has endopodite distinctly 2-jointed. First basal joint of fourth leg has knife-shaped spines on the inner margin (fig. *k*); the number of the spine is variable: according to GIESBRECHT, it is 6; A. SCOTT, 12; WITH, 15. Terminal spine of exopodite of second to fourth legs have 15, 17 and 16 teeth respectively.

Occurrence. One adult female from Sagami in the vertical hauls from 1000–0 m, Nov. 1937.

Distribution. The species has a wide distribution in the deep waters of the oceans.

Gaetanus pileatus FARRAN

(Fig. 43, *a–f*)

Gaetanus pileatus FARRAN, 1905, p. 33; ESTERLY, 1906, p. 57; A. SCOTT, 1909, p. 46; WOLFENDEN, 1911, p. 229; WITH, 1915, p. 104; SARS, 1925, p. 56; SEWELL, 1929, p. 103; FARRAN, 1936, p. 89; SEWELL, 1947, p. 59.

Female. Length, 6.14 mm: cephalothorax including cephalic spine 4.95 mm; abdomen, 1.19 mm; the greatest width of cephalothorax 1.75 mm. Cephalic spine has a characteristic shape (fig. *a*, *b*). Lateral spines of last thoracic segment divergent, and extend to the middle of genital segment (fig. *c*).

Abdomen 4-segmented; segments and furca with proportional lengths 44 : 17 : 14 : 9 : 16 = 100. Genital segment which is as long as wide, shows a sudden change in the continuity of the outline at the proximal two-fifths of the dorsal surface. Furcal rami as long as wide.

First antenna broken off. Second antenna with exopodite about as long as endopodite. First maxilla with 7 long and 2 short setae on outer lobe; third inner lobe with 3 setae and a conical process as shown in the figure (fig. *d*). Maxillipede has first basal joint about as long as the second; first joint has a lamellous process with a rounded tip on the posterior margin (fig. *e*).

First leg with 2-jointed exopodite which has no articulation between first and second joints. Second leg with 3-jointed exopodite and 2-jointed endopodite; the number of teeth on terminal spine of second to fourth legs are 20, 20 and 23 respectively. First basal joint of fourth leg bears about 16 lamellous bristles on the inner margin (fig. *f*).

Occurrence. One adult female from Sagami in the vertical hauls 1000–0 m, Nov. 1937.

Distribution. The species has been recorded from the west coast of Ireland, South Atlantic, Malay Archipelago, Indian Ocean, Denmark Strait, North-East Pacific.

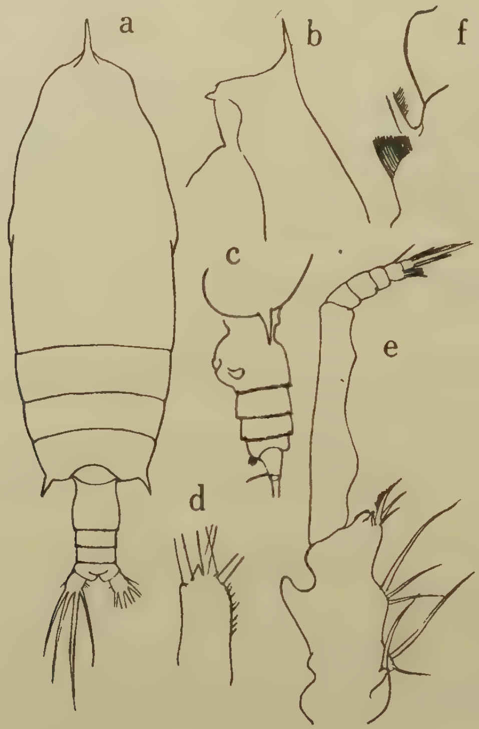

Fig. 43. *Gaetanus pileatus* FARRAN.
a, Female: dorsal aspect; *b*, head, lateral aspect; *c*, last thoracic segment and abdomen, lateral aspect; *d*, exopodite, endopodite and lobes of first maxilla; *e*, first leg; *f*. first basal joint of fourth leg; *g*, Male: fifth pair of legs.

Genus *Euchirella* GIESBRECHT, 1888

One species of this genus, *Euchirella amoena* GIESBRECHT, has been reported by MORI from Japanese waters. In the present collection I have found 9 species, of which two appear to be undescribed. The genus has the following characteristics: head usually separates from first thoracic segment; head with or without a crest; last thoracic segments fused; lateral corners of last thoracic segment rounded; rostrum usually present; abdomen 4-jointed in female; genital segment often asymmetrical; furcal rami about as long as wide; first antenna 23-jointed; endopodite of second antenna shorter than half the length of exopodite; second basal joint of first maxilla long; exopodite of first leg 2-jointed, those of the three following legs 3-jointed;

endopodite of first and second legs 1-jointed, those of third and fourth legs 3-jointed; first basal joint of female fourth leg has spines on the inner margin; fifth leg absent in female; male fifth pair of legs biramose on the right; left leg with a rudimentary endopodite. According to SARS the true member of the genus *Euchirella* are characterized by the reduction of joints of endopodite of second antenna, and by the reduction of the number of setae on endopodite of first maxilla.

Euchirella rostrata CLAUS

(Fig. 44, *a–g*)

Euchirella rostrata GIESBRECHT, 1892, p. 222; ESTERLY, 1905, p. 152; FARRAN, 1908, p. 38; SARS, 1935, p. 69; FARRAN, 1929, p. 234; WILSON, 1932, p. 55; JESPERSEN, 1934, p. 64; BRODSKY, 1950, p. 173.

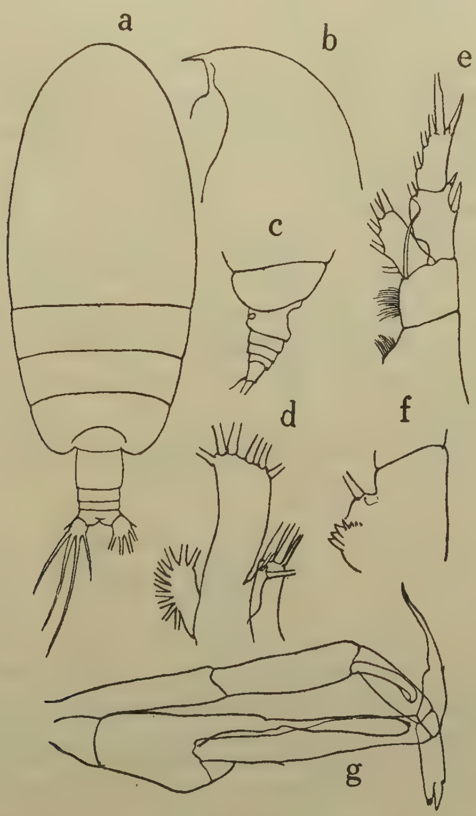

Fig. 44. *Euchirella rostrata* CLAUS.

a, Female: dorsal aspect; *b*, head, lateral aspect; *c*, last thoracic segment and abdomen, lateral aspect; *d*, exopodite and endopodite and lobes of first maxilla; *e*, first leg; *f*, first basal joint of fourth leg; *g*, fifth pair of legs.

Female. Length, 3.58 mm: cephalothorax, 2.95 mm; abdomen, 0.63 mm. Cephalothorax robust (fig. *a*, *b*, *c*). Rostrum long and pointed. Abdomen 4-segmented; segments and furca in the proportional lengths: 43:16:14:8:19=100. Genital segment has a small ventral process. Furcal rami about as long as wide.

First antenna 23-jointed, extends to distal end of third abdominal segment; second joint is much shorter than joints 8-9. Second antenna has exopodite 2-times as long as endopodite. First maxilla has 3 setae on second inner lobe, 2 setae and a conical process on third inner lobe, 9 setae on outer lobe, 10 setae on exopodite, 4 setae on endopodite, 2 setae on second basal joint (fig. *d*).

First leg as figured by GIESBRECHT (fig. *e*). The number of teeth on terminal spine of exopodite of second to fourth legs are in the specimen examined:

	second	third	fourth
right leg	18	20	23
left leg	17	20	20

Fourth leg has triangular lamellous plates on first basal joint (fig. *f*).

Male. Length, 3.01 mm: cephalothorax, 2.38 mm; abdomen, 0.68 mm. Cephalothorax slender. Head incompletely separates from first thoracic segment. Abdomen 4-segmented; segments and furca in the proportional lengths: 26:20:17:13:7:17=100; furcal rami about as long as wide. First antenna extends to distal end of fourth abdominal segment; joints 9–10, and 12–13 are partially fused. Second antenna with endopodite about 3/4-times as long as exopodite; setae on second basal joint well developed. Fifth pair of legs differ from those of the other members of the genus: right leg does not form a complete prehensile organ; left leg well developed (fig. *g*).

Occurrence. Common species among the genus, both from the surface and the deep waters of the Izu region.

Distribution. It is widely distributed in the Pacific, Atlantic, Mediterranean and California coast.

Euchirella pulchra (LUBBOCK)

(Fig. 45, *a–h*)

Euchirella pulchra GIESBRECHT, 1892, p. 233; A. SCOTT, 1909, p. 56; WILSON, 1932, p. 58; SEWELL, 1947, p. 80; VERVOORT, 1949, p. 20; BRODSKY, 1950, p. 175.

Female. Length, 3.47 mm: cephalothorax, 2.77 mm; abdomen, 0.70 mm. Cephalothorax ovate; forehead with a low crest; frontal organ prominent (fig. *a*). Rostrum short (fig. *b*). Abdomen 4-segmented; segments and furca in the proportional lengths: 52:15:13:5:15=100. Genital segment with a swelling on left side; right side is indented (fig. *c*). Furcal rami about as long as wide.

First antenna 23-jointed, extends about to distal end of third abdominal segment; joints are in the proportional lengths:

Joint	1	2	3	4	5	6	7	8–9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24–25
	45	39	23	21	24	21	24	39	27	30	27	48	48	65	63	69	63	69	56	50	47	42	42=1000.

Second antenna with exopodite 2.8–times as long as endopodite; second joint of endopodite with 6+6 setae. Mandible with exopodite about as long as endopodite. First maxilla as in *Euchirella messinensis* (fig. *d*). Maxillipede with two basal joints of about equal lengths; second joint has a row of spinules on the proximal anterior margin.

In first leg outer edge spine of third joint of exopodite about as long as the joint itself. Terminal spine of second to fourth legs have 20, 19 and 19 teeth respectively.

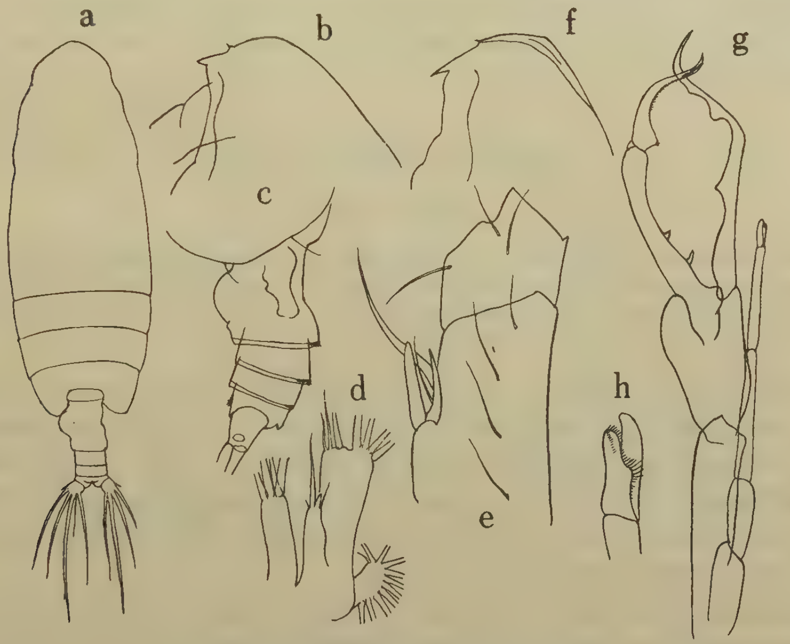

Fig. 45. *Euchirella pulchra* (LUBBOCK).

a. Female: dorsal aspect; *b*, head, lateral aspect; *c*, last thoracic segment and abdomen, lateral aspect; *d*, exopodite, endopodite and lobes of first maxilla; *e*, basal joints of fourth leg; *f*, Male: head, lateral aspect; *g*, fifth pair of legs; *h*, distal joint of exopodite of left fifth leg.

First basal joint of fourth leg has two subequal spines at the base of inner marginal seta, and scattered bristles on first and second basal joints (fig. *e*).

Male. Length, 3.06 mm: cephalothorax, 2.35 mm; abdomen, 0.71 mm; so abdomen is contained 3.3–times in the length of cephalothorax. Forehead with a low crest (fig. *f*). Last two thoracic segments are fused. Rostrum one-pointed. Abdomen

5-segmented; segments and furca in the proportional length: 25:23:19:19:2:12 =100; distal margin of second and third segments are fringed with teeth.

First antenna extends about to distal end of third abdominal segment; joints 8 and 9 are fused; joints 12 and 13 are incompletely fused. First maxilla with 3 short and long setae on outer lobe, 10 setae on exopodite, and 4 setae on endopodite.

First leg with 3-jointed exopodite; second joint of exopodite has a minute outer edge spine; articulation between first and second joints clearly observed on the anterior surface. Second leg has a completely fused endopodite. Fourth leg has no spine on inner distal margin of second joint; inner edge spine of first joint of endopodite has an accessory spine. Fifth pair of legs as figured by GIESBRECHT (fig. *g*, *h*).

Occurrence. Two adult females from Sagami, Nov. 1937, and one male from Suruga, Dec. 1937, from deep waters.

Distribution. The species appears to have a wide distribution; it has been recorded from the Pacific, Atlantic, Malay Archipelago, San Diego region, and Mediterranean Sea.

Euchirella messinensis (CLAUS)

(Fig. 46, *a–g*)

Undinella messinensis CLAUS, 1863, p. 187; *Euchirella messinensis* GIESBRECHT, 1892, p. 232, t. 15, 36; A. SCOTT, 1909, p. 115; WOLFENDEN, 1911, p. 237; WITH, 1915, p. 122; SARS, 1925, p. 63; FARRAN, 1926, p. 253; SEWELL, 1929, p. 115; WILSON, 1932, p. 56; VERVOORT, 1949, p. 28; BRODSKY, 1950 p. 172.

Female. Length, 5.26 mm: cephalothorax, 4.07 mm; abdomen, 1.19 mm. Rostrum rather slender and acute, directs downwards (fig. *a*, *b*). Abdomen 4-segmented; segments and furca in the proportinal lengths 49:18:12:6:15=100; dorsal protuberance of genital segment differs from the figure given by GIESBRECHT or SARS: it is much smaller and exceeds slightly the distal margin of genital segment, and situated rather on the middle of the dorsal surface (fig. *c*).

First antenna extends to the middle of second abdominal segment. Mouth parts and swimming legs as those of the foregoing species; endopodite of first maxilla has 4 setae. Fourth leg with two spines on the inner margin of first basal joint; terminal spine of the exopodite has 20 teeth (fig. *d*).

Male. Length, 4.62 mm: cephalothorax, 3.37 mm; abdomen, 1.25 mm; abdomen is contained 2.7-times in the length of cephalothorax. Forehead with low crest. Rostrum moderately long (fig. *e*). Lateral corners of last thoracic segment rounded. Second and third abdominal segments are furnished with coarse teeth on the distal margin.

First antenna 22-jointed, extends to the middle of second abdominal segment; proportional lengths of joints are as follows:

Joint	1	2	3	4	5	6	7	8–9	10	11	12–13	14	15	16	17	18	19	20	21	22	23	24–25
	37	45	22	22	25	22	30	40	27	30	75	47	70	42	75	65	75	60	47	52	45	47=1000;

joints 24–25 are 1.06–times as long as the 23rd; but they are 4–times in *Euchirella pulchra*; joint 18 is shorter than the 17th in the present specimen, but it is of about equal length in *E. pulchra*. Mouth parts and first to third swimming legs as those of *E. pulchra*. In fourth leg second basal joint has two minute spines near the inner distal margin. Fifth pair of legs resemble those of *E. pulchra*, but endopodite of right leg is longer than the combined lengths of two basal joints (fig. *f*, *g*).

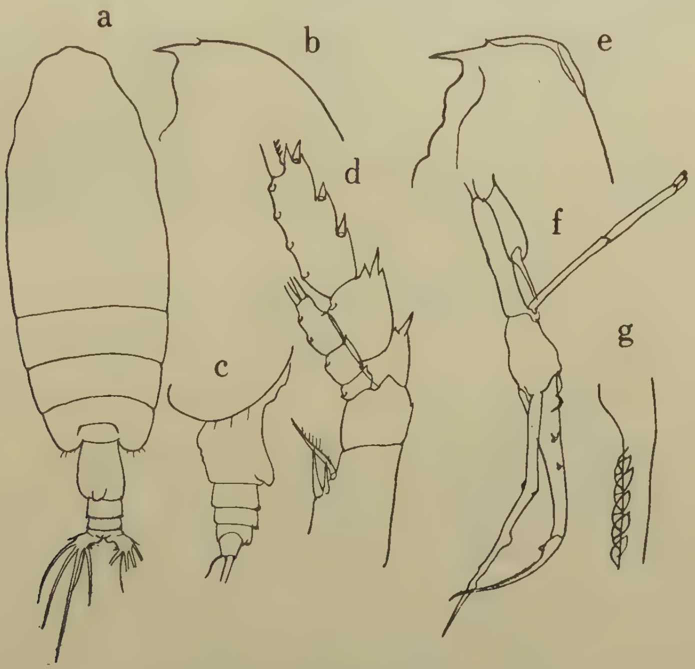

Fig. 46. *Euchirella messinensis* (Claus).

a, Female: dorsal aspect; *b*, head, lateral aspect; *c*, last thoracic segment and abdomen, lateral aspect; *d*, fourth leg; *e*, Male: head lateral aspect; *f*, fifth pair of legs; *g*, a part of distal joint of exopodite of right fifth leg.

Occurrence. One of the most common species in the deep water of Sagami and Suruga Bay.

Distribution. The species is widely distributed in the deep waters of the Pacific (San Diego), Atlantic, Indian Oceans, also from the Mediterranean and Malay Archipelago.

Euchirella venusta GIESBRECHT

(Fig. 47, *a–g*)

Euchirella venusta GIESBRECHT, 1892, p. 336; A. SCOTT, 1909, p. 57; FARRAN, 1929, p. 237; SEWELL, 1947, p. 85; VERVOORT, 1949, p. 20.

Female. Length, 4.88 mm: cephalothorax, 3.88 mm; abdomen, 1.00 mm. General appearance as in *E. messinensis* (fig. *a*, *b*, *c*). Abdominal segments and furca in the proportional lengths 54 : 13 : 11 : 5 : 18 = 100. Genital segment asymmetrical; there is a remarkable protuberance on the left side of the segment; the proximal dorsal surface is hollowed; the ventral protuberance situated anterior to the genital opening is very prominent. Furcal rami about as long as wide.

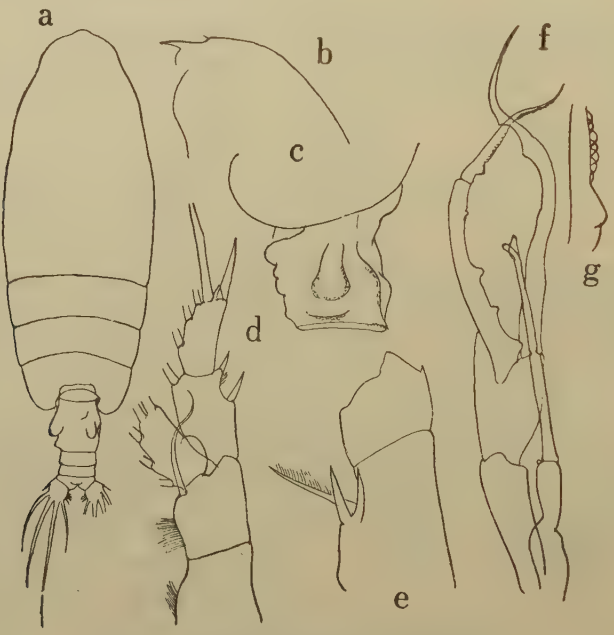

Fig. 47. *Euchirella venusta* GIESBRECHT.
a, Female: dorsal aspect; *b*, head, lateral aspect; *c*, last thoracic segment and genital segment, lateral aspect; *d*, first leg; *e*, basal joints of fourth leg; *f*, Male: fifth pair of legs; *g*, a part of distal joint of exopodite of right fifth leg.

First antenna 23–jointed, extends to distal end of genital segment; joints are in the proportional lengths:

Joint	1	2	3	4	5	6	7	8–9	10	11	12	13	14	15	16	17
	45	48	23	20	23	20	23	36	24	28	28	48	50	68	64	72

18	19	20	21	22	23	24–25
64	68	60	48	44	38	48=1000.

Second antenna with exopodite about 3.4 times as long as endopodite. Mandible blade is robust and has a long inner edge seta. First maxilla has 11 setae on exopodite, 4 setae on endopodite, 6 setae on outer lobe, 3 setae on second basal joint. Second maxilla without characteristic features. Maxillipede as that of *E. messinensis*; outer margin of second basal joint has two swellings on the distal half of the joint.

First leg has 2 outer edge spines on outer margin of first joint of exopodite as in other members of the genus (fig. *d*).

Terminal spine of exopodite of second to fourth legs have 20, 21 and 20 teeth respectively. Fourth leg has two spines reaching the proximal margin of second basal joint on the inner margin of first basal joint at the base of inner marginal seta (fig. *e*).

Male. Length, 3.70 mm: cephalothorax, 2.95 mm; abdomen, 0.75 mm. General appearance as in the female. Head without crest. First antenna reaches back to distal margin of first abdominal segment. Fifth pair of legs closely resemble those of *E. messinensis* (fig. *f*, *g*).

Occurrence. Two adult females and a male from Suruga in the vertical hauls 1000–0 m, July, 1937.

Distribution. The species has been recorded from the Atlantic, and Malay Archipelago.

Euchirella intermedia WITH

(Fig. 48, *a–f*)

Euchirella intermedia WITH, 1915, p. 124; SARS, 1925, p. 68; VERVOORT, 1947, p. 28.

Female. Length, 6.19 mm: cephalothorax, 5.25 mm; abdomen, 0.94 mm. Cephalothorax ovate. Frontal margin of head produced triangularly. Articular membrane between head and first thoracic segment faintly visible; last two thoracic segments incompletely fused. (fig. *a*). Lateral corners of last thoracic segment rounded (fig. *c*). Rostrum slightly curved posteriorly; rostral spine slender (fig. *b*).

Abdomen is contained 5.6–times in the length of cephalothorax; segments and furca in the proportional lengths 51:12:8:15:13=100. Genital segment asymmetrical: the left side is in dorsal view more inflated about the middle of the segment; lateral distal corner of the left side has a process which is concave at the apical portion (fig. *d*).

First antenna 24–jointed, extends to distal end of furca. First maxilla has 5 setae on endopodite, 3 setae on second basal joint, of which two are very short (fig. *e*).

In fourth leg first basal joint has a single spine extending to the distal margin of the joint on the inner margin at the base of the inner marginal seta (fig. *f*).

Remarks. The species is easily recognised by the shape of genital segment, and a single strong spine on first basal joint of fourth leg. WITH's specimen measured 5.66 mm, SARS' 6.20 mm.

Occurrence. One adult female from Suruga in the depth 400–200 m, March, 1940.

Distribution. The species has been recorded from the North Atlantic.

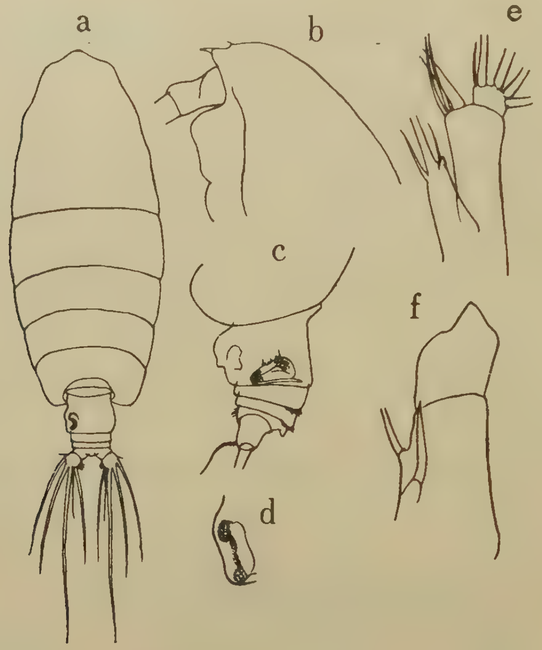

Fig. 48. *Euchirella intermedia* WITH.
a, Female: dorsal aspect; *b*, head, lateral aspect; *c*, last thoracic segment and abdomen, lateral aspect; *d*, protuberance on left margin of genital segment; *e*, endopodite and lobes of first maxilla; *f*, basal joints of fourth leg.

Euchirella trigrada sp. nov.

(Fig. 49, *a–h*)

Female. Length, 5.23 mm: cephalothorax, 4.33 mm; abdomen, 0.90 mm; the greatest width of cephalothorax, 1.70 mm. General appearance as in *E. intermedia* WITH (fig. *a*). Head and first thoracic segment separate. Rostrum directs straight forwards; rostral spine moderately long (fig. *b*).

Abdomen 4-segmented; segments and furca in the proportional lengths 60 : 10 : 8 : 6 : 16 = 100. Genital segment which is as deep as wide is shorter than wide; the segment is in dorsal view slightly asymmetrical; there are on the left side 3 lamellous processes of which the distal two are broad at the base; there is a blunt process on the right side; genital area as that of *E. intermedia*. Furcal rami shorter than wide.

First antenna 23-jointed, reaches back to distal end of furca; joints are in the following proportional lengths:

Joint	1	2	3	4	5	6	7	8–9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24–25
	39	45	26	23	26	26	26	49	34	34	30	49	52	52	52	56	67	75	56	45	49	38	52=1000;

joints 3, 7, 9, 14 and 18 have each a long seta; aesthetasks are found on joints 9, 12, 14 and 19. Second antenna with exopodite about 3.7-times as long as endopodite; first basal joint has a tuft of hairs on the posterior surface (fig. *d*). First maxilla as that of *E. messinensis*; second basal with 3 setae, endopodite with 4 setae, exopodite with 11 setae. Second maxilla as that of *E. rostrata*. Maxillipede with sinuate anterior margin on second basal joint (fig. *e*).

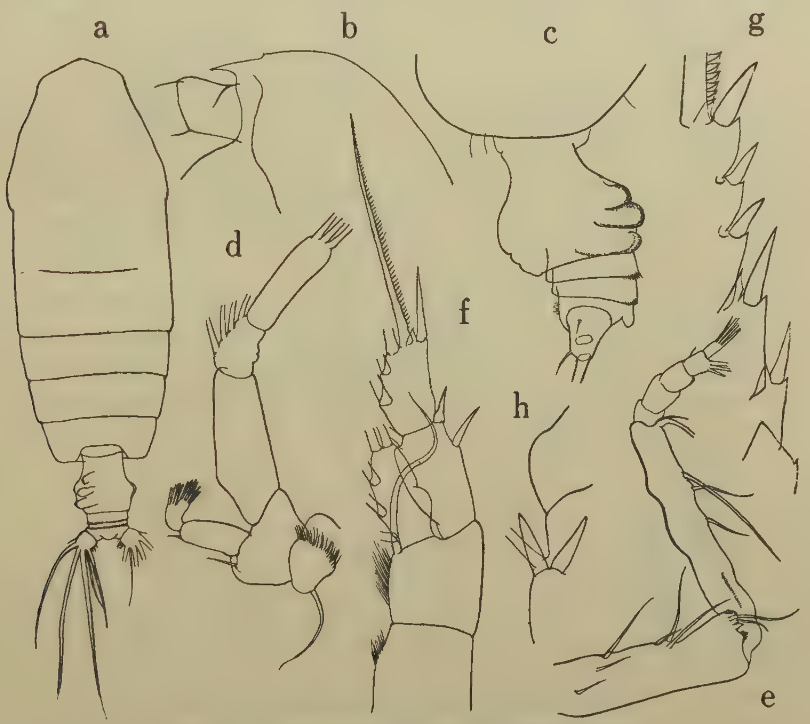

Fig. 49. *Euchirella trigrada* sp. nov.

a, Female: dorsal aspect; *b*, head, lateral aspect; *c*, last thoracic segment and genital segment; *d*, second antenna; *e*, maxillipede; *f*, first leg; *g*, outer margin of exopodite of second leg; *h*, inner margin of basal joints of fourth leg.

First leg as that of other members of the genus (fig. *f*). Second leg has strong outer edge spines on joints of exopodite (fig. *g*). Terminal spines of exopodite of second to fourth legs have each 20 teeth. Fourth leg has two subequal spines on posterior surface of first basal joint (fig. *h*).

Remarks. The present specimen closely resembles *E. intermedia* With but genital segment and first basal joint of fourth leg are quite different from the former.

Occurrence. Five adult females from Suruga in the hauls 1000–0 m, Nov. 1937.

Euchirella areata sp. nov.

(Fig. 50, *a–h*)

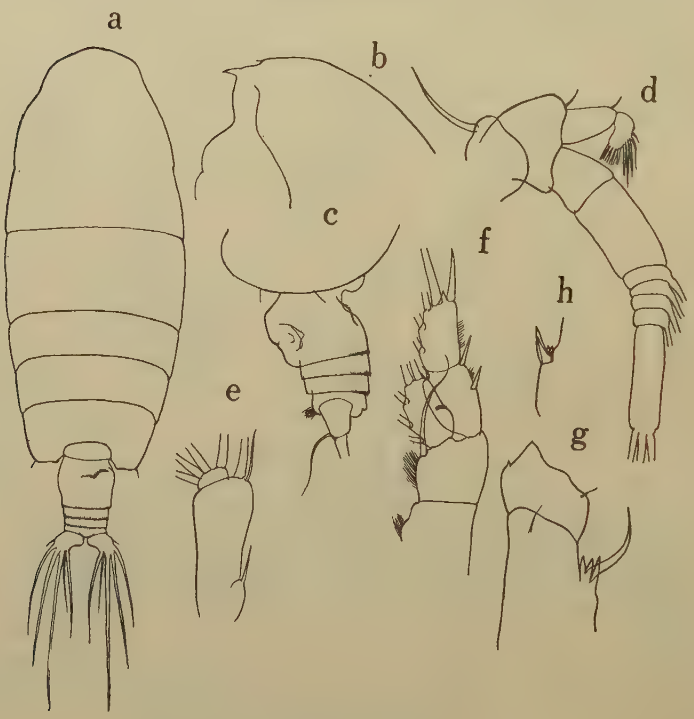

Fig. 50. ***Euchirella areata*** sp. nov.

a, Female: dorsal aspect; *b*, head, lateral aspect; *c*, last thoracic segment and abdomen, lateral aspect; *d*, second antenna; *e*, endopodite and second basal joint of first maxilla; *f*, first leg; *g*. basal joints of fourth leg; *h*, inner margin of first basal joint of fourth leg.

Female. Length, 3.75 mm: cephalothorax, 3.06 mm; abdomen, 0.69 mm. Cephalothorax oblong ovate. Head separates from first thoracic segment; last two thoracic segments are fused (fig. *a*). Lateral corners of last thoracic segment rounded (fig. *c*). Rostrum small. Frontal organ prominent (fig. *b*).

Abdomen 4-segmented; segments and furca in the proportional lengths 51 : 13 : 10 : 8 : 18 = 100. Genital segment asymmetrical; the right side is more inflated on the lateral margin; dorsal surface is concave at the proximal half, and there is a slight protuberance on the periphery of the hollow on the right side.

First antenna 24-jointed, exceeds distal end of furca by distal two joints; joints are in proportional length:

Joint	1	2	3	4	5	6	7	8–9	10	11	12	13	14	15	16	17
	50	36	23	23	23	18	23	36	27	27	27	48	50	66	68	70

	18	19	20	21	22	23	24	25
	66	68	59	50	46	41	41	14=1000;

joints 8 and 9 are separate on the posterior margin. Second antenna has a very short endopodite about 1/5 the length of exopodite; distal joint of endopodite has 10 setae (fig. *d*). Mandible has exopodite a little longer than endopodite (10 : 8). In first maxilla endopodite has 4 setae, second basal has 2 setae, of which the proximal one is very short (fig. *e*). Second maxilla and maxillipede as those of *E. rostrata.*

First leg has 2-jointed exopodite; first joint of exopodite has 2 outer edge spines (fig. *f*). Second and third legs as those of *E. rostrata.* In fourth leg first basal joint has on the inner face spines of which the outer one is notched at the apex (fig. *g*); the spine of the left fourth leg was broken off, but the indication of bifurcation is slightly observed (fig. *h*).

Remarks. The specimen resembles *E. rostrata*, but differs from it in the followings: large size, small rostrum, shape of genital segment, structure of second antenna, and spine of the inner face of first basal joint of fourth leg.

Occurrence. One adult female from Sagami in the hauls 1000–0 m, Oct. 1938.

Euchirella curticauda GIESBRECHT

(Fig. 51, *a–g*)

Euchirella curticauda GIESBRECHT, 1892, p. 233, t. 15, 36; A. SCOTT, 1909, p. 55; WOLFENDEN, 1911, p. 236; WITH, 1915, p. 118; SARS, 1925, p. 72; FARRAN, 1926, p. 251; SEWELL, 1929, p. 109; WILSON, 1932, p. 59; JESPERSEN, 1934, p. 64; BRODSKY, 1950, p. 176.

Female. Length, 3.50 mm: cephalothorax, 3.00 mm; abdomen, 0.50 mm. Line of fusion between head and thoracic segment faintly observed (fig. *a*). Head with median crest; frontal organ prominent; rostrum very short (fig. *b*). Abdomen 4-segmented; segments and furca in the proportional length 52 : 8 : 12 : 8 : 22=100. Genital segment has lateral projections on each side of genital opening when viewed from the ventral (fig. *c*). Furcal rami 1.6-times as wide as long.

First antenna extends to distal end of last thoracic segment; joint 2 is longer than joints 8–9, which are about as long as joint 13th or 14th. Second antenna with exopodite 4 times as long as endopodite; first joint of exopodite with a process on the inner margin. First maxilla with 9 setae on outer lobe, 11 setae on exopodite, 3 setae on endopodite, 3 setae on second basal, 4 setae on second inner lobe, 4 setae on third inner lobe. Second maxilla robust and stout. Maxillipede has on first basal joint a knob-like process on the anterior surface near the distal margin.

Second leg with a strong outer edge spine on second joint of exopodite; terminal spine of exopodite with 20 teeth (fig. *d*). Fourth leg with 24 teeth on terminal spine of exopodite; first basal joint has 11 spines on the left, and 8 on the right at the base of inner marginal seta (fig. *e*).

Male. Length, 3.14 mm: cephalothorax, 2.45 mm; abdomen, 0.70 mm. General appearance as in the female. Rostrum more distinct. Abdominal segments and furca in the proportional lengths 27 : 22 : 19 : 16 : 5 : 11 = 100. Furcal rami shorter than wide. First antenna extends to distal end of thoracic segment; joints are in the following proportional lengths:

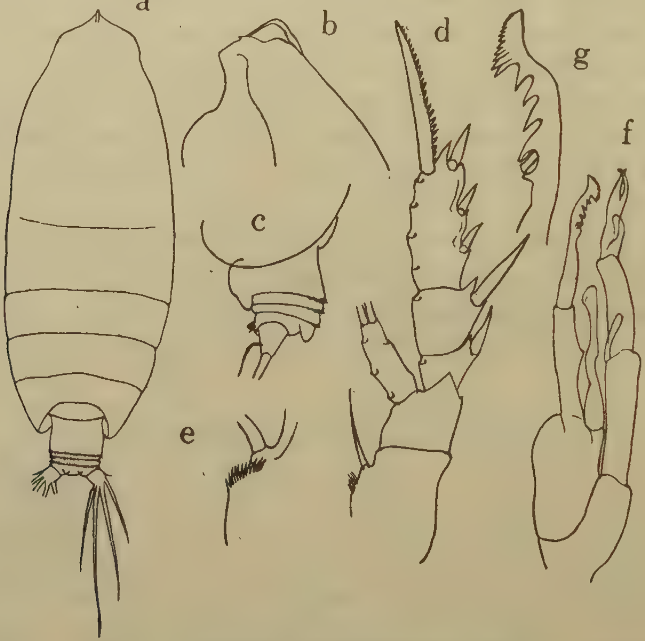

Fig. 51. *Euchirella curticauda* GIESBRECHT.

a, Female: dorsal aspect; *b*, head, lateral aspect; *c*, last thoracic segment and abdomen, lateral aspect; *d*, second leg; *e*, inner margin of first basal joint of fourth leg; *f*, Male: fifth pair of legs; *g*, distal joint of exopodite of right fifth leg.

Joint	1	2	3	4	5	6	7	8–9–10	11	12	13	14	15	16	17
	66	63	26	23	26	20	30	76	26	70	46	63	60	63	52
	18	19	20	21	22	23	24–25								
	53	60	53	43	46	41	50 = 1000;								

joints 20 and 21 are fused on the right side. Second antenna with endopodite about

3/4 as long as exopodite. First leg with a slender exopodite. Fifth pair of legs as figured by SARS (fig. *f*, *g*).

Occurrence. One adult female from Suruga, Dec. 1937, and two males from Sagami, Nov. 1937, in the vertical hauls from 1000 m to the surface.

Distribution. The species has a wide distribution in the Pacific, Atlantic, Indian Oceans, Mediterranean Sea and Malay Archipelago.

Euchirella bitumida WITH

(Fig. 52, *a*–*e*)

Euchirella bitumida WITH, 1915, p. 131; SARS, 1925,; FARRAN, 1926, p. 253; VERVOORT, 1949, p. 35.

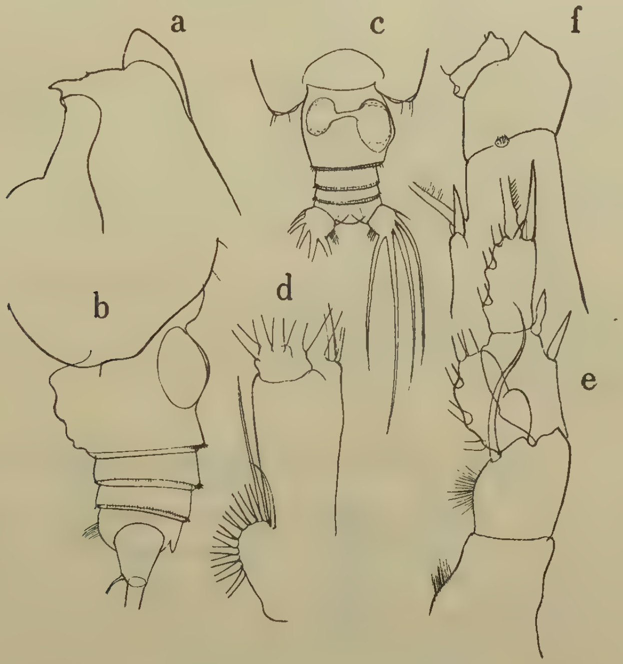

Fig. 52. *Euchirella bitumida* WITH.
a, Female: head, lateral aspect; *b*, last thoracic segment and abdomen, lateral aspect; *c*, last thoracic segment and abdomen, dorsal aspect; *d*, exopodite and endopodite of first maxilla; *e*, first leg; *f*, basal joints of fourth leg.

Female. Length, 6.07 mm: cephalothorax, 4.95 mm; abdomen, 1.12 mm; so abdomen is contained 4.4-times in the length of cephalothorax. Head is produced into helmet-shaped crista and fused with first thoracic segment (fig. *a*, *c*). Lateral corners of last thoracic segment rounded (fig. *b*). Rostrum short.

Abdomen 4–segmented; segments and furca in the proportional length 50 : 15 : 11 : 12 : 12 = 100. Genital segment has two protuberances: the one on the right side is better marked than that on the left; the ventral side of the segment is bluntly produced near the proximal part. First three segments are fringed with fine teeth on the distal border. Furcal rami wider than long.

First antenna extends nearly to distal end of abdomen; proportional lengths of the distal joints are as follows:

Joint	15	16	17	18	19	20	21	22	23	24–25
	22	21	23.5	20	22	18	14	14	11.5	14.

Second antenna with exopodite 3.6–times as long as endopodite. First maxilla with 7 setae on exopodite, 4 setae on endopodite, 3 setae on second basal (fig. *d*). Second maxilla very stout; spine on fifth lobe has peculiar rows of spinules. Maxillipede has second basal joint 1.3–times as long as the first, and is more than 2–times as long as the combined length of joints of endopodite.

In first leg first and second joints of exopodite completely fused; outer edge spine of third joint of exopodite is equal in length to the joint itself (fig. *e*). Second leg with 1–jointed endopodite. In fourth leg inner margin of first basal joint has a moderately long spine at the base of the inner marginal seta; there is a spot furnished with minute spinules on the line of demarcation between first and second basal joints (fig. *e*). The number of teeth on terminal spine of second leg is 21, and that of third leg 20.

Occurrence. One adult female from Suruga, Dec. 1937, and two females from Sagami, Nov. 1937 in the vertical hauls 1000–0 m.

Distribution. The species, though unrecorded from the Indian seas, appears to be widely distributed in the deep waters of the oceans.

Genus *Chirundina* Giesbrecht, 1895

There has only one species *Chirundina streetsi* Giesbrecht been known untill Sewell (1929) reported the occurrence of the second species, *Chirundina indica*, from the Indian waters; one of which appeared in the Izu region. The genus, closely allied to *Euchirella* and *Undeuchaeta*, has the generic characters in the following: head has a crest; rostrum one-pointed and well developed; lateral corners of last thoracic segment produced backwards into blunt processes; endopodite of second antenna about half the length of exopodite; the spinulation of endopodite of first maxilla not reduced; exopodite of first leg 2–jointed; fourth leg without spine on the inner margin of first basal joint.

Chirundina streetsi Giesbrecht

(Fig. 53, *a–i*)

Chirundina streetsi Giesbrecht, 1895, p. 250; Farran, 1908, p. 37; A. Scott, 1909, p. 43, pl. 7; With, 1915, p. 41; Sars, 1925, p. 77; Sewell, 1947, p. 95; Brodsky, 1950, p. 180.

Female. Length, 5.01 : cephalothorax, 3.95 mm ; abdomen, 1.06 mm. Head with a median crest (fig. *a*, *b*). Rostrum one-pointed and strong (fig. *d*). Lateral corners of last thoracic segment produced triangularly with each a pointed knob at the apex (fig. *c*).

Abdomen 4-segmented ; segments and furca in the proportional lengths 48 : 19 : 12 : 5 : 16 = 100. Genital segment is swollen toward the distal end ; ventral surface of the segment has a moderate protuberance just above genital opening. Posterior margin of third segment is fringed with fine teeth. Furcal rami about as long as wide.

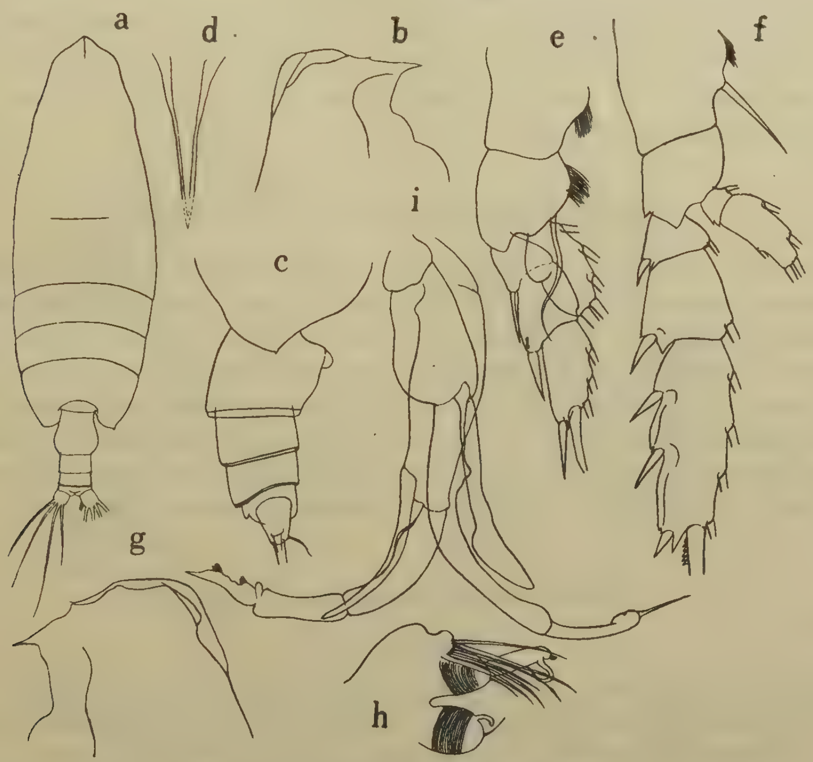

Fig. 53. *Chirundina streetsi* GIESBRECHT.

a, Female : dorsal aspect ; *b*, head, lateral aspect ; *c*, last thoracic segment and abdomen, lateral aspect ; *d*, rostrum, anterior aspect ; *e*, first leg ; *f*, second leg ; *g*, Male : head, lateral aspect ; *h*, second maxilla ; *i*, fifth pair of legs.

First antenna 23-jointed, exceeds slightly distal end of furca ; joint 8–9, and 24–25 are fused. Second antenna with exopodite 1.6-times as long as endopodite.

In first leg exopodite incompletely 3-jointed ; the articular membrane between first and second joints is observed distinctly on the anterior surface (fig. *e*). In second leg first joint of endopodite has an accessory tooth (fig. *f*).

Male. Length, 4.81 mm : cephalothorax, 3.50 mm ; abdomen, 1.31 mm. Head has a median crest (fig. *g*). Lateral corners of last thoracic segment rounded. Abdomen 5-segmented; segments and furca in the proportional length 23 : 32 : 27 : 20 : 7 : 11 = 100; second to fourth segments are fringed with fine teeth on the posterior margin.

First antenna extends to the middle of the second abdominal segment; the left one is 21-jointed; the right 20-jointed. Maxillae and maxillipede are reduced; second maxilla as shown in the figure (fig. *h*).

First leg with 3-jointed exopodite and 1-jointed endopodite. Second leg with 33 teeth on the terminal spine of exopodite. Third leg with 24 teeth. Fourth leg with 33 teeth. Fifth pair of legs as figured by Sars (fig. *i*).

Occurrence. Two females from Sagami, one female and two males from Suruga, Dec. 1937, in the vertical hauls 1000–0 m.

Distribution. It is widely distributed in the Pacific, Atlantic, but has not been reported from the Indian seas.

Genus *Pseudochirella* G. O. Sars, 1920

The genus was created to accomodate a number of species that were intermediate in character between *Euchirella* and *Undeuchaeta.* The genus resembles *Euchirella* in general appearance, and, especially, in having spines on inner margin of first basal joint of fourth leg. The well-developed endopodite of second antenna shows a close relationship to *Undeuchaeta.* First maxilla has more increased number of setae on endopodite than in *Euchirella.* First and second joints of exopodite of first leg are incompletely fused; endopodite of the second leg incompletely fused. Three species were found in the collection, of which two appear to be undescribed.

Pseudochirella pustulifera G. O. Sars

(Fig. 54, *a–g*)

Chirundina pustulifera With, 1915, p. 145; *Pseudochirella pustulifera* Sars, 1925, p. 85, pl. 24; Wilson, 1932, *Chirundina pustulifera* Wilson, 1932, p. 49; *Pseudochirella pustulifera* Jespersen, 1934, p. 65.

Female. Length, 6.26 mm: cephalothorax, 4.95 mm; abdomen, 1.31 mm. Head incompletely separates from first thoracic segment; fourth and fifth thoracic segments are separate (fig. *a*). Rostrum strong, directs backwards; frontal organ prominent (fig. *b*). Lateral corners of the last thoracic segment rounded (fig. *c*).

Abdomen 4-segmented; segments and furca in the proportional length 43 : 19 : 14 : 10 : 14 = 100. Genital segment is of characteristic shape: remarkable protuberance on each side of the segment; they are more prominent than those figured by previous authors; second segment is setose on the ventral surface; distal margin of second and third segments fringed with fine teeth; furcal rami as long as wide.

First antenna 23-jointed, extends to distal end of third abdominal segment; joints

8–9, 13–14 are of about equal lengths; joint 19 is the longest. Second antenna with exopodite about 1.6–time as long as endopodite (43 : 26); posterior surface of first basal joint has a tuft of hairs. Mandible robust, carries 3 setae on second basal joint; biting part has strong teeth. First maxilla has the following number of setae; exopodite has 11 setae, outer lobe has 7+2 setae; first joint of endopodite has 4 setae; second joint has 5 setae; third has setae; second basal 5 setae; third inner lobe has 4 setae and a conical process; second inner lobe has 5 setae. Second maxilla very robust. Maxillipede has a small conical process on fourth lobe of first basal.

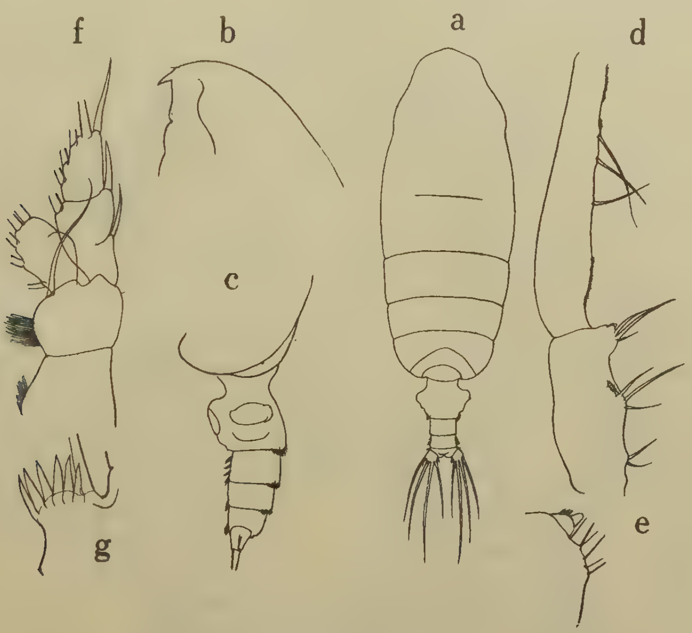

Fig. 54. *Pseudochirella pustulifera* G. O. SARS.
a, Female: dorsal aspect; *b*, head, lateral aspect; *c*, last thoracic segment and abdomen, lateral aspect; *d*, basal joints of maxillipede; *e*. distal margin of first basal joint of maxillipede; *f*, first leg; *g*, inner margin of first basal joint of fourth leg.

In first leg articulation between first and second joint of exopodite is distinct only on the anterior surface. Articulation between first and second joints of endopodite of second leg is observed on the anterior surface; terminal spine of exopodite has about 74 teeth. Fourth leg has six fairly long spines on the inner margin of first basal joint. Some of mouth appendages and swimming legs are of crimson colour.

Occurrence. Two adult females from Sagami, Nov. 1937, and one female from Suruga, Dec. 1937, in the vertical hauls 1000–0 m.

Distribution. It has been recorded only from the North Atlantic. This is the first record from Japanese waters.

Pseudochirella polyspina BRODSKY

(Fig. 55, *a–f*)

Pseudochirella polyspina BRODSKY, 1950, p. .

Female. Length, 6.28 mm: cephalothorax, 4.90 mm; abdomen, 1.38 mm; the greatest width of cephalothorax, 2.00 mm. Head separates indistinctly from first thoracic segment; last two thoracic segments separate. Lateral corners of last thoracic segment rounded (fig. *a*, *b*). Rostrum moderately long and strong, directs posteriorly. Abdomen 4-segmented; segments and the furca in the proportional lengths 47 : 20 : 13 : 7 : 13=100. Genital segment is furnished with hairs on the lateral proximal and

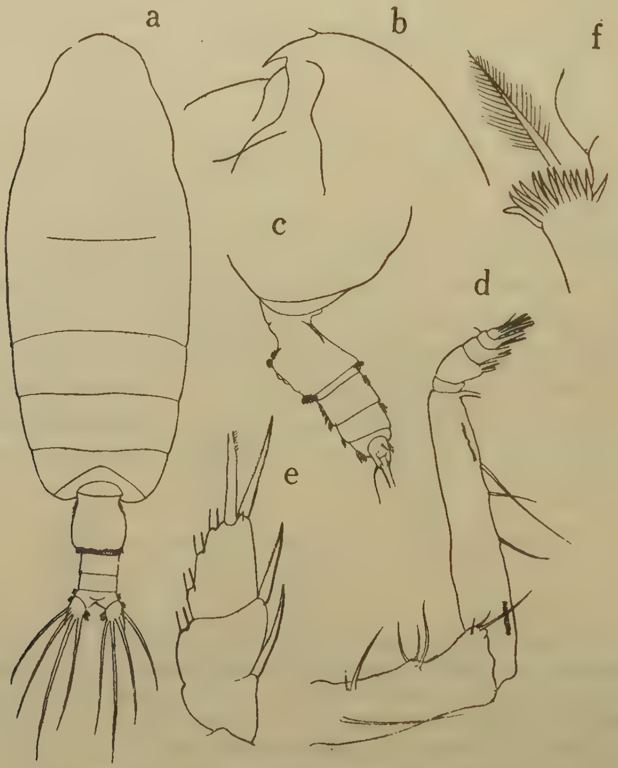

Fig. 55. *Pseudochirella polyspina* BRODSKY.
a, Female: dorsal aspect; *b*, head, lateral aspect; *c*, last thoracic segment and abdomen, lateral aspect; *d*, maxillipede; *e*, exopodite of first leg; *f*, inner margin of first basal joint of fourth leg.

distal margins, and also on the ventral side at the base of genital opening, and on the distal ventral margin. Furcal rami about as long as wide (fig. *c*).

First antenna 23-jointed, extends to distal end of furca ; joints are in the following proportional lengths :

Joint	1	2	3	4	5	6	7	8-9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24-25
	37	46	31	31	34	31	31	50	27	31	27	43	43	50	53	56	50	65	62	43	50	53	56=1000 ;

first joint has a swelling on the posterior margin. Second antenna has exopodite 3/5 as long as endopodite. Mandible has a strong biting part, the tooth on the outer margin is long. First maxilla has the following spinulation : 7 long and 2 short setae on outer lobe ; 11 setae on exopodite ; 15 setae on endopodite ; 5 setae on second basal joint ; 4 setae and a small process on third inner lobe ; 5 setae on second inner lobe. Second maxilla as that of *P. pustulifera*. Maxillipede has second basal joint 1.5 times as long as the first ; anterior distal margin of the joint has a row of spinules, and a double rows of spinules on the proximal margin (fig. *d*).

First leg has a slender outer edge spine on the joints of the exopodite ; first and second joints are incompletely fused (fig. *f*). Second and third legs have no interesting features. Fourth leg has 13 spines on inner margin of first basal.

Remarks. The present specimen, though a little larger than that described by BRODSKY, agrees quite well with his *P. polyspina* taken from the Far-Eastern seas. This is the same species to which I gave a new *P. dura* in the systematic list of the pelagic copepods of the Izu region published in "Records of Oceanographic Works in Japan", N. S., Vol. 1, No. 1, 1953.

Pseudochirella tuberculata sp. nov.

(Fig. 56, *a–g*)

Female. Length 6.10 mm : cephalothorax, 5.00 mm ; abdomen, 1.10 mm. Head separates distinctly from first thoracic segment ; fourth and fifth thoracic segments incompletely separate (fig. *a*, *b*). Lateral corners of last thoracic segment asymmetrical : left side is evenly rounded, but right side carries a rounded process on the posterolateral margin ; lateral corners are furnished with short hairs (fig. *c*, *d*). Rostrum strong, directs somewhat posteriorly.

Abdomen 4–jointed ; segments and furca in the proportional lengths 49 : 16 : 11 : 6 : 18=100. Genital segment wider than long, slightly asymmetrical : left side is more inflated than the right. Furcal rami about as long as wide. Abdominal segments and furca very setose.

First antenna 23–jointed, extends to distal end of genital segments ; proportional lengths of joints as follows :

Joint	1	2	3	4	5	6	7	8–9	10	11	12	13	14	15	16	17
	22	26	26	26	30	31	31	53	30	32	30	50	45	55	58	61

	18	19	20	21	22	23	24–25
	53	74	70	45	53	53	56=1000.

Second antenna has endopodite slightly longer than half the length of exopodite (19 : 10). Mandible blade very strong. First maxilla has 5 setae on second basal joint, 15 setae on endopodite, 11 setae on exopodite, 7 long and 2 short setae on outer lobe. Maxillipede has strong setae on fourth and fifth lobes of first basal joint; basal joints and exopodite are in proportional length 42 : 74 : 23.

First leg has the joints of exopodite fused between the first and second; outer edge spines slender and long (fig. *e*). Second leg has 2-jointed endopodite articulated on the anterior surface (fig. *f*). Fourth leg has 7 long spines on the inner margin of first basal joint at the base of inner marginal seta (fig. *g*).

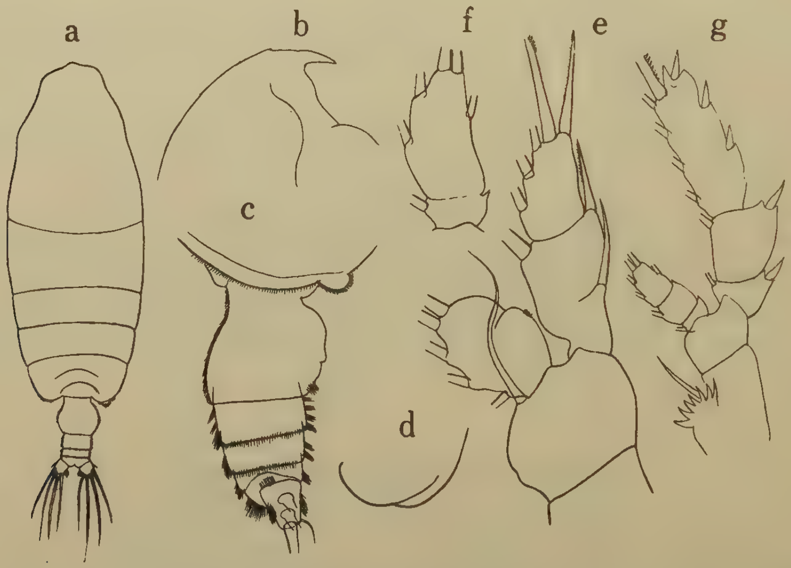

Fig. 56. *Pseudochirella tuberculata* sp. nov.
a, Female: dorsal aspect; *b*, head, lateral aspect; *c*, last thoracic segment and abdomen, lateral aspect; *d*, last thoracic segment, left side, lateral aspect; *e*, first leg; *f*, endopodite of second leg; *g*, fourth leg.

Remarks. The present specimen is quite different from the other members of the genus in the shape of genital segment and lateral corners of the last thoracic segment.

Occurrence. One adult female from Suruga, July, 1937, and one female from Sagami, Nov. 1937, in the hauls 1000–0 m.

Genus *Chirundinella* gen. nov.

Definition. Cephalothorax elongate ovate; head separates from first thoracic segment; fourth and fifth thoracic segments are fused; head has a median crest; rostrum one-pointed. Abdomen 4-jointed in female; outer marginal seta of furca short; appendicular seta very long. First antenna 24-jointed, joints 8–9 are fused, joints 24 and 25 are separate. Second antenna has exopodite which is longer than endopodite. Mandible has a small endopodite which is slightly longer than half the length of exopodite; biting part robust. First maxilla has 4 setae on second basal joint, 10 setae on endopodite. Second maxilla and maxillipede resemble those of *Pseudochirella*. First leg has 3-jointed exopodite and 1-jointed endopodite. Second leg has 3-jointed exopodite and 2-jointed endopodite. Third and fourth legs have each 3-jointed exopodite and endopodite; fourth leg has a row of bristles on inner margin of first basal joint. Fifth leg absent in the female. Male unknown.

Chirundinella cara sp. nov.

(Fig. 57, *a–j*)

Female. Length, 7.44 mm: cephalothorax, 6.00 mm; abdomen, 1.44 mm; abdomen is contained 4.2-times in the length of cephalothorax (fig. *a*). Lateral corners of last thoracic segment rounded (fig. *c*). Rostrum as in *Chirundina*; the basal part robust, and directs somewhat posteriorly (fig. *b*).

Abdomen 4-segmented; segments and furca in the proportional lengths 42:15:12:17:14=100. Genital segment produced moderately below; first three segments are fringed with serrated plates (fig. *c*). Furcal rami about as long as wide (12:11); appendicular seta about 3-times as long as second inner seta (fig. *d*).

First antenna 24-jointed, exceeds distal end of furca by distal three joints; joints are in the following proportional lengths:

Joint	1	2	3	4	5	6	7	8–9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
	67	30	19	19	20	20	23	47	21	23	26	38	40	53	51	55	57	74	72	57	80	59	40	20=1000;

joints 3, 7, 9, 18 and 21 are each furnished with a long seta. Second antenna has endopodite a little more than half the length of exopodite (33:52). Mandible has endopodite 3/5 the length of exopodite (25:42); second basal joint has two inner marginal setae (fig. *e*). First maxilla has 4 setae on second basal joint, 10 setae on the endopodite. The number of setae on second basal joint and endopodite of first maxilla in *Chirundina*, *Pseudochirella* and *Undeuchaeta* are as follows:

	second basal joint	endopodite
Chirundina	5	14
Pseudochirella	5	14–15
Undeuchaeta	5	10

Thus the present specimen agrees with *Undeuchaeta* in the number of setae on endopodite. Second maxilla as that of *Chirundina streetsi*, but the strong seta on fifth lobe appears to be more slender than that of *C. streetsi* (fig. *f*). Maxillipede has a slender second basal joint; two proximal setae on second basal joint are very closely set together; there is a row of spinules along the proximal anterior margin of second basal joint (fig. *g*).

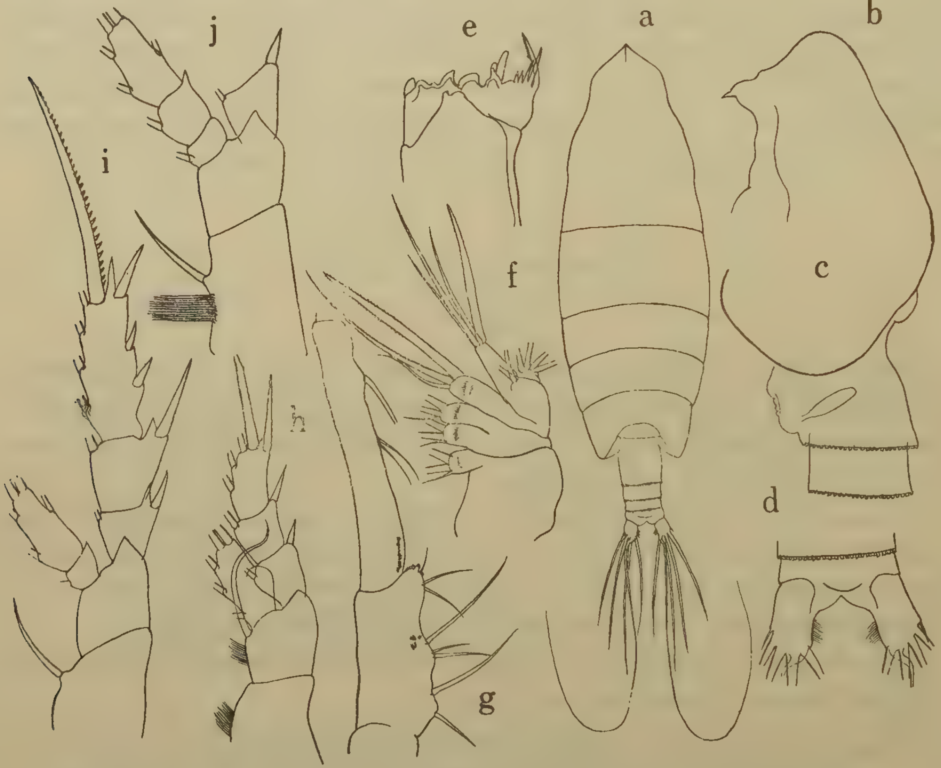

Fig. 57. *Chirundinella cara* sp. nov.

a, Female: dorsal aspect; *b*, head, lateral aspect; *c*, last thoracic segment and genital segment, lateral aspect; *d*, anal segment and furca, dorsal aspect; *e*, cutting edge of mandible; *f*, second maxilla; *g*, basal joints of maxillipede; *h*, first leg; *i*, second leg; *j*, endopodite and basal joints of fourth leg.

First leg has 3-jointed exopodite; line of demarcation between first and second joints of exopodite is distinct; outer edge spine of third joint of exopodite is the longest (fig. *h*). In second leg outer edge spine of second joint of exopodite reaches the level of proximal spine of third joint; terminal spine as long as the combined lengths of the three joints of the exopodite taken together, and has 30 serrations; endopodite distinctly 2-jointed (fig. *i*). Third leg has 3-jointed exopodite and endopodite; terminal spine has 24 serrations. In fourth leg first basal joint has a row of long bristles, about ten in number, on the inner margin near the base of inner marginal seta; terminal spine of exopodite has 22 serrations (fig. *j*).

Remarks. The present specimen has a general resemblance to *Chirundina*, and also, in some respects to *Undeuchaeta* and *Pseudochirella*, but appendicular seta, the number of setae on second basal joint and endopodite of first maxilla, and the structure of first and second legs, and also in fourth leg, are the characteristic features which distinguish the species from the other members of the closely allied genus.

Occurrence. One adult female from Sagami in a haul 1000–0 m, Nov. 1938.

Genus *Undeuchaeta* GIESBRECHT, 1888

Up to the present time I have detected three species of the genus: *Undeuchaeta major* GIESBRECHT, *U. plumosa* (LUBBOCK) and the other species which appears to be undescribed. The genus is closely allied to *Chirundina*: head fused with thoracic segment; last two thoracic segments are fused; head with or without crest; last thoracic segment bluntly produced in female, rounded in the male; rostrum one-pointed; furcal rami short, appendicular seta short; first antenna 23-jointed; endopodite of second antenna more than half the length of exopodite; exopodite of first maxilla short, the number of seta on endopodite unreduced; second maxilla as in *Aetideus*; endopodite of maxillipede very short; endopodite of second leg 1-jointed; fifth leg absent in female. In male exopodite of first leg 3-jointed; fifth pair of legs biramose.

Undeuchaeta plumosa (LUBBOCK)

(Fig. 58, *a–m*)

Undeuchaeta minor GIESBRECHT, 1892, p. 228; ESTERLY, 1905, p. 149; FARRAN, 1905, p. 198; FARRAN, 1908, p. 37; *Undeuchaeta plumosa* A. SCOTT, 1909, p. 62; *Undeuchaeta minor* WOLFENDEN, 1911; SARS, 1925, p. 79; FARRAN, 1926, p. 253; FARRAN, 1929, p. 233; WILSON, 1932, p. 61; *Undeuchaeta plumosa* FARRAN, 1936, p. 89; BRODSKY, 1950, p. 181.

Female. Length, 3.61 mm: cephalothorax, 2.80 mm; abdomen, 0.81 mm. Head fused with first thoracic segment; fourth and fifth thoracic segments fused. Lateral corners of last thoracic segment asymmetrical: left side is produced bluntly triangularly (fig. *a*, *b*, *c*). Rostrum short and stout, directs downwards.

Abdomen 4-segmented; segments and furca in the proportional lengths 45 : 24 : 20 : 2 : 9 = 100. Genital segment asymmetrical, carries a dorsal spine on the right margin about the middle, and a row of hairs on the distal corner; left lateral margin has near the base a low protuberance or something like cement substance which runs posteriorly about to the two-thirds of the segment; the lateral distal corners of the segment are furnished with groups of short hairs. Second segment with spinules on the distal margin. Furcal rami 1.5–times as wide as long (fig. *c*, *d*, *e*).

First antenna 23–jointed, extends to distal end of genital segment; proportional lengths of joints as follows:

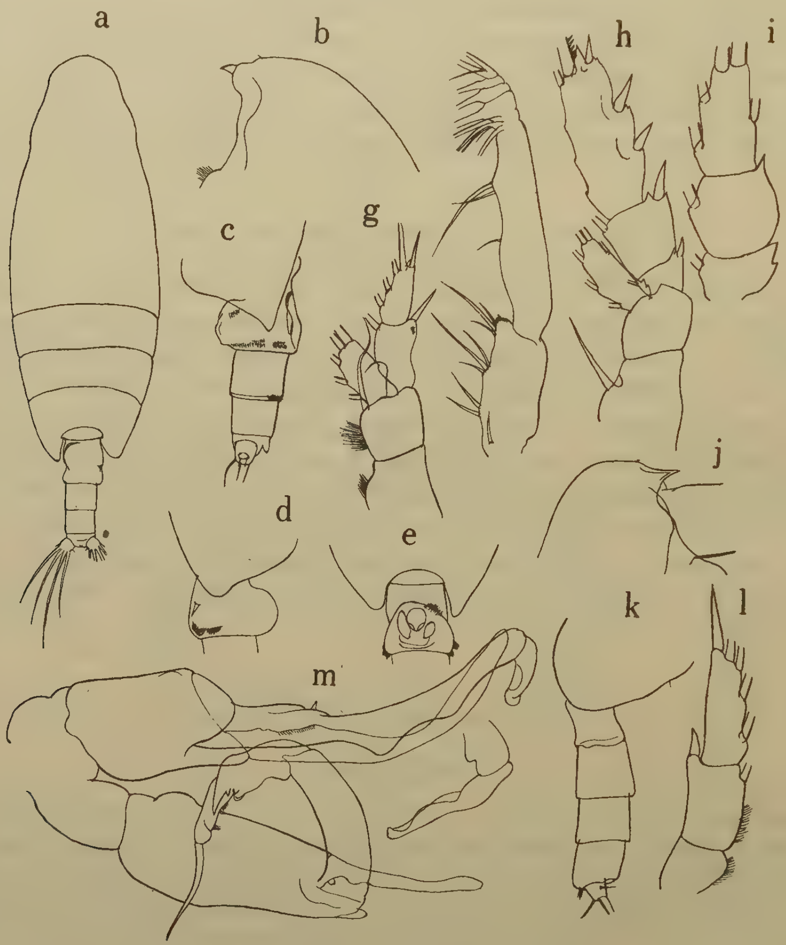

Fig. 58. *Undeuchaeta plumosa* (Lubbock).

a, Female: dorsal aspect; *b*, head, lateral aspect; *c*, last thoracic segment and abdomen, lateral aspect; *d*, last thoracic segment and genital segment, right side, lateral aspect; *e*, last thoracic segment and genital segment, ventral aspect; *f*, maxillipede; *g*, first leg; *h*, second leg; *i*, endopodite of fourth leg; *j*, Male: head, lateral aspect; *k*, last thoracic segment and abdomen, lateral aspect; *l*, exopodite of first leg; *m*, fifth pair of legs.

Joint	1	2	3	4	5	6	7	8–9	10	11	12	13	14	15	16	17
	57	33	33	29	33	33	34	49	33	33	29	52	43	55	60	53

18	19	20	21	22	23	24–25
49	60	52	43	43	49	49=1000;

joint 17 is the longest; last two joints are of equal lengths. Second antenna with exopodite 2–times as long as endopodite. In first maxilla outer lobe has 9 setae, of which the proximal four are short; exopodite with 11 setae, of which 4 are longer. Second basal joint of maxillipede is about 2–times as long as the first; endopodite is half the length of first basal joint (fig. *f*).

In first leg first and second joints of exopodite fused (fig. *g*). Second leg with 1–jointed endopodite; outer edge spine on proximal margin of endopodite has an accessory tooth (fig. *h*). Third and fourth legs with 3–jointed endopodite (fig. *i*). Terminal spine of exopodite of second to fourth legs with 32, 26 and 26 teeth respectively.

Male. Length, 3.45 mm: Abdomen is contained 2.7–times in the length of cephalothorax. Lateral corners of last thoracic segment rounded (fig. *k*). Rostrum short, directs straight downwards (fig. *j*).

Abdomen 5–segmented; segments and furca in the proportional length 23:30:26:20:2:9=100. Anal segment is very short, and concealed beneath the fourth. Second and third segments are furnished with minute teeth on the posterior margin. Second furcal seta about 2–times as long as the others; appendicular seta very short.

First antenna 21–jointed, extends to distal end of last thoracic segment; articular menbranes faintly visible between joints 9 and 10, and between joints 12 and 13; joints are in the proportional lengths:

Joint	1	2	3	4	5	6	7	8–9–10	11	12–13	14	15	16	17
	73	43	22	23	26	30	33	73	30	73	40	45	55	60

18	19	20	21	22	23	24–25
56	63	55	45	45	53	56=1000.

Second antenna and the other mouth parts are not characteristic.

First leg with a short outer edge spine on second joint of exopodite (fig. *l*). In second leg outer marginal spine on second and third joints of exopodite are of equal lengths. Fifth pair of legs are very characteristic as shown in the figure: endopodite of left leg is about as long as first joint of exopodite; in right leg second basal joint is longer than first joint of the exopodite; third joint of exopodite is elongated (fig. *m*).

Occurrence. 27 females and 6 males from Sagami, and one female and one male from Suruga in the vertical hauls 1000–0 m, Nov. 1937.

Distribution. The species appears to be widely distributed in the oceans, and has been recorded from the Pacific, Atlantic and Malay Archipelago, but not from the Indian seas.

Undeuchaeta major GIESBRECHT

(Fig. 59, *a–h*)

Undeuchaeta major GIESBRECHT, 1892, p. 227; ESTERLY, 1905, p. 148; FARRAN, 1905, p. 35; FARRAN, 1908, p. 37; A. SCOTT, 1909, p. 61; WOLFENDEN, 1911, p. 243; WITH, 1915, p. 136; SARS, 1925, p. 81; FARRAN, 1926, p. 254; FARRAN, 1929, p. 233; WILSON, 1932, p. 60; SEWELL, 1947, p. 104; BRODSKY, 1950, p. 182.

Female. Length, 4.43 mm: cephalothorax, 3.55 mm; abdomen, 0.88 mm. Head with a median crest (fig. *a*, *b*). Lateral corners of last thoracic segment asymmetrical: right side is not pointed at the apex (fig. *e*, *d*). Abdomen 4-segmented; segments and the furca in the proportional lengths 47 : 23 : 18 : 2 : 10 = 100. Genital segment asymmetrical: right side has a small protuberance on the lateral margin about the

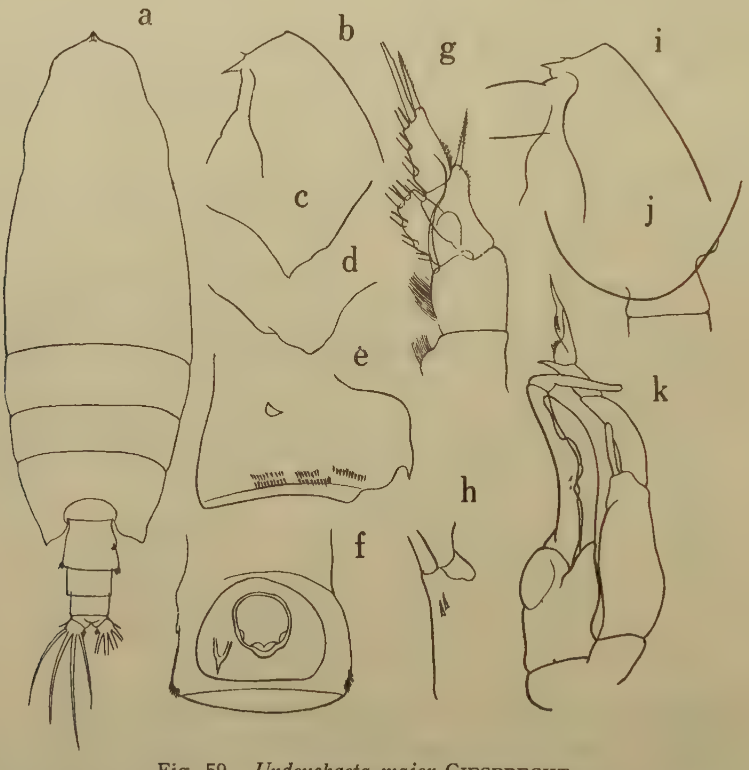

Fig. 59. *Undeuchaeta major* GIESBRECHT.
a, Female: dorsal aspect; *b*, head, lateral aspect; *c*, last thoracic segment, and abdomen, left side, lateral aspect; *d*, genital segment, right side, lateral aspect; *e*, genital segment, ventral aspect; *g*, first leg; *h*, inner margin of first basal joint of fourth leg; *i*, Male: head, lateral aspect; *j*, last thoracic segment, left side, lateral aspect; *k*, fifth pair of legs.

middle; there is on ventral side of the segment a sharp spine near the genital opening (fig. *e*, *f*).

First antenna 23-jointed, extends to the end of second abdominal segment; proportional lengths of the joints are:

Joint	1	2	3	4	5	6	7	8–9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24–25
	61	45	27	27	31	31	31	49	27	32	28	49	45	56	61	65	49	61	53	41	41	45	45=1000;

joint 17 is more than 2-times as long as the 12th whereas, according to WITH, it is scarcely, not distinctly twice as long as the 12th=second antenna with exopodite about 1.7-times as long as endopodite. Mandible, maxillae as described by GIESBRECHT. Maxillipede has second basal joint 1.7-times as long as the first.

First leg as the description given by WITH (fig. *g*). Fourth leg with two small spines on posterior surface of first basal joint (fig. *h*).

Male. Length, 4.12 mm: cephalothorax, 3.06 mm, abdomen, 1.06 mm. Forehead with a median crest (fig. *i*). Lateral corners of last thoracic segment rounded (fig. *j*). Abdominal segments and furca in the proportional lengths 18 : 28 : 23 : 20 : 3 : 8=100. Furcal rami as long as wide. First antenna 21-jointed, extends to distal end of second abdominal segment. Fifth pair of legs resemble those of *Undeuchaeta plumosa*; endopodite of left leg is shorter than first joint of exopodite of the same leg (fig. *k*).

Occurrence. Four females and two males from Sagami, Nov. 1937 in the hauls 1000–0 m.

Distribution. The species is widely distributed in the Pacific, Atlantic and Malayan region.

Undeuchaeta magna sp. nov.

(Fig. 60, *a–f*)

Female. Length, 6.07 mm: cephalothorax, 4.89 mm, abdomen, 1.18 mm; abdomen is contained 4.1-times in the length of cephalothorax. Head distinctly separates from first thoracic segment; fourth and fifth thoracic segments are fused (fig. *a*). Forehead with a median crest. Rostrum one-pointed, short, and broad at the base in lateral view (fig. *b*). Last thoracic segment slightly asymmetrical: left side is triangularly produced, and pointed at the apex; right side is irregularly rounded, with a small prominence on the postero-lateral corner (fig. *c*).

Abdominal segments and furca in the proportional lengths 41 : 21 : 21 : 5 : 12=100. Genital segment has a protuberance which is much larger than that of *U. major*; ventral spine near genital opening is smaller than that of *U. major* (fig. *c*, *d*, *e*). Furcal rami longer than wide.

First antenna extends to the end of furca; joints are in the proportional lengths:

Joint	1	2	3	4	5	6	7	8–9	10	11	12	13	14	15	16	17
	61	52	30	30	30	33	33	46	31	31	31	46	40	55	61	67
	18	19	20	21	22	23	24–25									
	46	61	52	38	42	44	42=1000.									

Mouth appendages as those of the foregoing species.

Swimming legs not so characteristic. First leg as shown in the figure (fig. *f*). Terminal spine of exopodite of second to fourth legs with 40, 32 and 33 teeth respectively. Spinules on the posterior surface of second basal joint of fourth leg absent (fig. *g*).

Remarks. The present specimen, though closely resembles *U. superba* WITH, is distinguished from it in the shape of crest, lateral process of genital segment, and absence of the teeth on second basal joint of fourth leg.

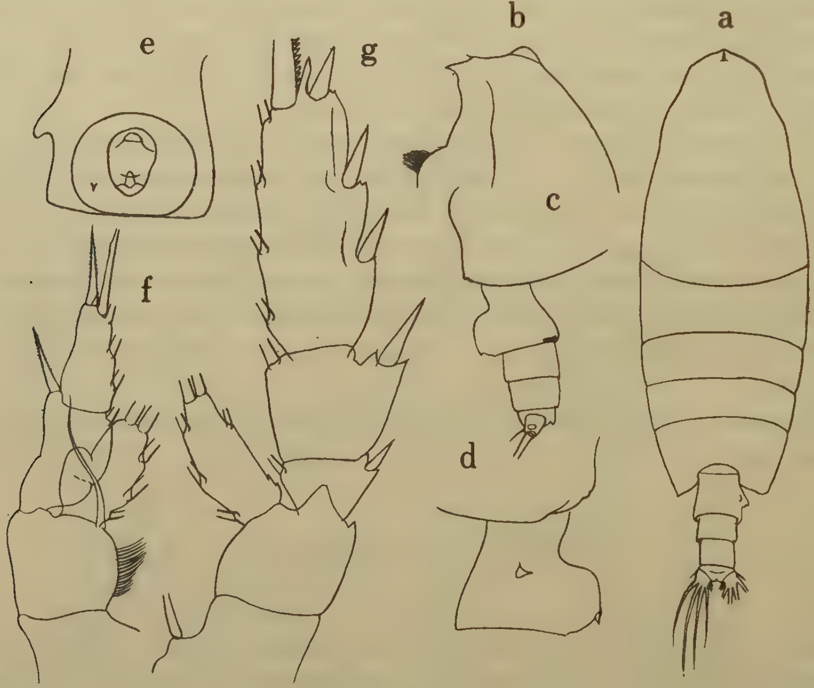

Fig. 60. *Undeuchaeta magna* sp. nov.

a, Female: dorsal aspect; *b*, head, lateral aspect; *c*, last thoracic segment and abdomen, lateral aspect; *d*, last thoracic segment and genital segment, left side, lateral aspect; *e*. genital segment, ventral aspect; *f*, first leg; *g*, second leg.

Occurrence. One adult female from Suruga in the haul 1000–0 m, July, 1937.

Genus *Valdiviella* STEUER, 1904

Six species of this genus, *Valdiviella brevicornis* SARS, *V. insignis* FARRAN, *V.*

ignota Sewell, *V. minor* Wolfenden, *V. oligarthra* Steuer and *V. gigas* (Brady), have been reported from the Indian seas by Sewell, one of which *V. oligarthra* was found in the collection. The genus *Valdiviella* was created by Steuer to accomodate a new species which is closely related to *Euchaeta* Phillipi, and also to some genera of Aetidaeidae. According to Steuer the genus has the mandible similar in structure to those of *Gaetanus* and *Chiridius*; first maxilla as in *Undeuchaeta*; second maxilla as in *Aetideus*. The genus *Valdiviella* is regarded as a member of the family Aetideidae, whereas Sars and A. Scott have classed it in the family Euchaetidae. A. Scott states "the genus is closely related to *Euchaeta*, but easily recognised by its bifurcate rostrum; the incomplete jointing of the exopodites of the first and second pairs of feet, and indistinctly 3-jointed endopodites of the third and fourth pair of feet are the characters of this genus." He does not mention about the systematic position of the genus. The genus has the following characters: general appearance as in *Euchaeta*; head and first thoracic segments are fused; fourth and fifth thoracic segments are fused; posterior margins of last thoracic segment are rounded; the abdomen 4-jointed; appendicular seta short; endopodite of second antenna about as long as exopodite; endopodite of mandible about as long as exopodite; first maxilla differs from that of *Euchaeta*: setae on the endopodite and second basal joint much reduced; endopodite has only three, second basal has three setae, whereas that of *Euchaeta* has 3+3+3 setae on endopodite, and five on second basal; second maxilla resembles that of *Aetideus*, setae on fifth lobe strong; maxillipede resembles that of *Undeuchaeta* and *Euchaeta*, but row of spinules on the anterior margin of second basal joint are situated on the proximal half, whereas, it is on the distal half in *Euchaeta*, and they are feeble. First leg as in *Euchirella*: first and second joints of the exopodite are fused; endopodite of second leg one-jointed, that of third leg 2-jointed; fourth leg has 3-jointed exopodite and endopodite; fifth pair of legs absent in female; male fifth pair of legs resemble those of *Chirundina*. The genus has a closer relationship to Aetideidae in the followings: rostrum resembles that of *Aetideopsis* or *Undinopsis* in its bifurcate form; maxilla has the reduced number of setae on endopodite and on second basal; second maxilla as those of *Aetideus* in having a strong seta on fifth lobe; first legs are similar to those of *Euchirella*; second leg also as in *Euchirella* or *Undechaeta*. The genus has resemblance to *Euchaeta* in the followings: general appearance, and the structure of first antenna, mandible and maxillipede. Thus the genus *Valdiviella* has the generic characters which are in common both to Aetideidae and Euchaetidae. It is the intermediate form between *Undeuchaeta* and *Euchaeta*. It seems reasonable, at present, as Steuer stated, to accomodate it in the Family Aetideidae.

Valdiviella oligarthra Steuer

(Fig. 61, *a–g*)

Valdiviella oligarthra Steuer, 1904, p. 593; Wolfenden, 1911, p. 247; Sewell, 1929, p. 140.

Female. Length, 9.57 mm : cephalothorax, 6.38 mm ; abdomen, 3/19 mm. Cephalothorax oval ; head separates incompletely from first thoracic segment ; fourth and fifth thoracic segments are fused (fig. *a*). Lateral corners of last thoracic segment rounded (fig. *b*). Rostrum two-pointed, and short ; frontal prominence low (fig. *b*). Abdomen 4-jointed ; it is contained 2-times in the length of cephalothorax ; segments and furca in the proportional lengths 40 : 23 : 19 : 8 : 10 = 100. Genital area indented in lateral view ; second and third segments are each furnished with a tuft of hairs on the ventral side near the proximal margin ; first three segments are fringed with fine teeth on the distal margin (fig. *c*). Furcal rami as long as wide.

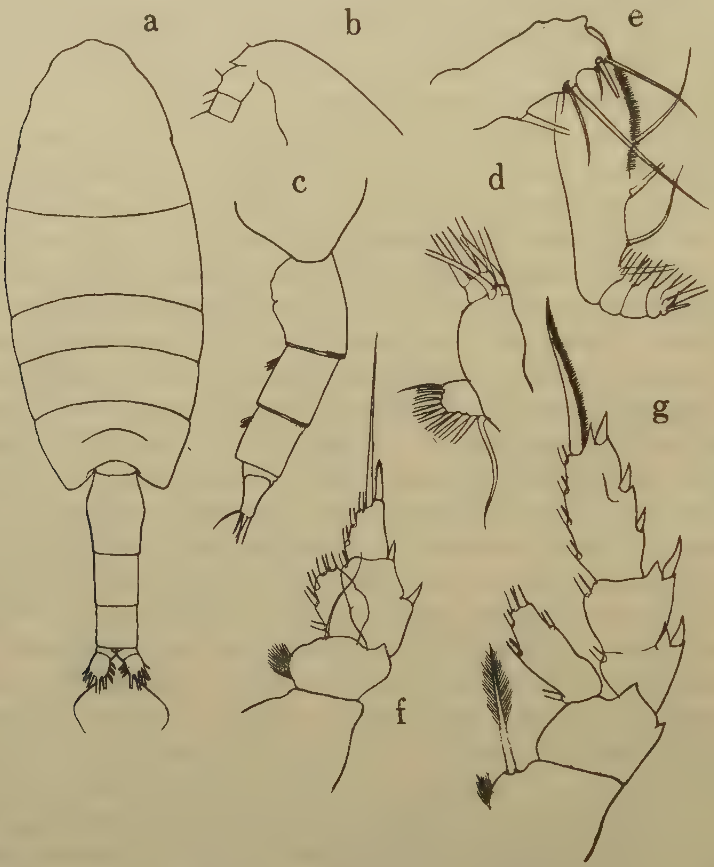

Fig. 61. *Valdiviella oligarthra* STEUER.
a, Female : dorsal aspect ; *b*, head, lateral aspect ; *c*, last thoracic segment and abdomen, lateral aspect ; *d*, exopodite and endopodite of first maxilla ; *e*, maxillipede ; *f*, first leg ; *g*, second leg.

First antenna 23-jointed, extends to distal end of third thoracic segment when pressed against the body; joints are in the following proportional lengths:

Joint	1	2	3	4	5	6	7	8–9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24–25
	49	42	33	39	45	45	36	42	10	13	16	27	27	42	59	65	45	72	65	52	45	52	59=1000.

Second antenna and the other mouth parts as described in the generic character. Maxillipede as shown in the figure (fig. *e*).

First leg has 2–jointed exopodite and one-jointed endopodite (fig. *f*). Second to fourth legs have each 2-jointed exopodite; viz. joint 1 and 2 of exopodite are fused; endopodite of second leg one-jointed (fig. *g*); those of third and fourth legs 2–jointed.

Remarks. The specimen agrees well with *V. oligarthra*, in having short first antenna, and 2–jointed exopodite in first to fourth legs. In *V. brevicornis* first and second joints of exopodite of first to fourth legs are separate. The specimen from the Indian seas measured 7.2 mm in the female.

Occurrence. One adult female from Suruga in a haul 1000–0 m, Nov. 1938.

Distribution. The species has been recorded only from the Atlantic and Indian Oceans.

PLANKTON INVESTIGATION IN INLET WATERS ALONG THE COAST OF JAPAN

XX. DIURNAL CHANGE OF PLANKTON ANIMALS AT AN INNERMOST STATION IN WAKAYAMA HARBOR[1]

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With 12 Text-figures and 2 Tables

Many works have already been made on the diurnal migration of plankton animals in fresh- and salt waters (Russell 1925–1934, Kikuchi 1930, 1939, Clarke 1933, 1934a & b, Johnson 1938, Motoda 1953, Motoda and Isida 1950, and Motoda and Sato 1949). In the enclosed sea water, Kikuchi (1930) found that some copepods, cladocerans, chaetognaths and brachyuran zoea appeared abundantly at the time of sunset or a few hours after, but only *Evadne* sp. was distributed on the surface during daytime and migrated downward to the depth at night. Many workers reported that various plankton animals in sea water are abundantly distributed in the optimum range of light intensity and they change the distribution according to the weather condition as well as to the time in a day. Thus, it has been generally recognized that light intensity is an important factor governing the diurnal movement (Russell 1926, Clarke 1933, Johnson 1938, Kikuchi 1939 and Motoda 1953). Marumo and Kawarada (1951) and Kawarada (1952) stated that the quantity of plankton in Sagami Bay fluctuated diurnally in accordance with physical and chemical changes of water—especially water mass movements.

Kikuchi (1938) learned by the experiment that phototropic sign of crustaceans changes with the intensity of light; some species are positive to weak light but negative to strong light, and others are indifferent to weak light and negative to very strong light. Johnson (1938) proved experimentally on the phototropic movement of *Acartia clausi* that the decrease in light intensity forces the plankton animals to migrate upward, and the greater the change of light intensity, the greater the upward movement. And he said that the animals are not seeking an optimum intensity since their distribution becomes uniform when left for some time under the intensity moving first upward.

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Publl. Seto Mar. Biol. Lab., VI (2), 1957. (Article 13)

The preliminary observations were made to obtain further information on the diurnal migration of plankton animals in relation to environmental conditions in inlet waters. The observation on the diurnal change of plankton abundance on the surface layer was carried out three times at a station in the innermost part of Wakayama Harbor, chosen as representing a typical stagnant environment of inlet water, during the period from March 25, 1947 to April 10, 1947; namely, March 25–26, March 30–April 1 and April 9–10 respectively (Fig. 1).

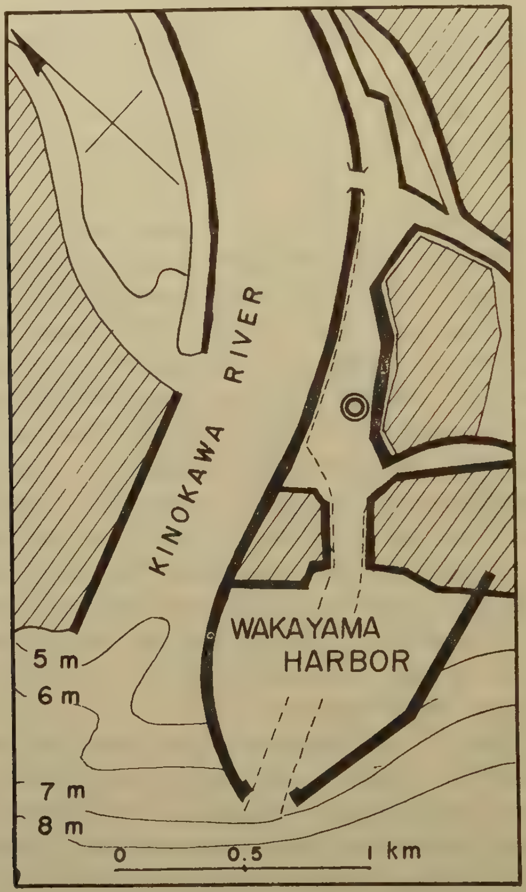

Fig. 1. Station position of investigation in Wakayama Harbor.

To collect plankton in the respective layers from the surface to the 6.5 m depth, or at the surface layer, 15 liters of sea water were pumped up by a bucket at intervals of an hour throughout the day and night, and filtered through a silk net stretching XX 14 gauze. Then, all the plankton animals were counted on the counting slide. The hydrological conditions were also measured at the same time. The results are given in Tables 1 and 2.

Table 1. Vertical distribution of hydrological conditions at an innermost station of Wakayama Harbor.

	Date	March				April			March			April			
		26	30	31	”	1	9	10	26	”	”	9	10	”	”
	Hour	11:00	13:00	5:00	18:00	6:00	18:00	6:00	11:00	11:00	11:00	18:00	6:00	11:00	15:00
Depth (m)	0	9.9	10.6	9.7	12.5	11.9	14.3	11.6	13.18	8.1	6.85	6.72	6.15	6.26	6.02
	1	9.4	10.5	10.1	12.4	12.0	13.7	12.0	13.18	8.2	6.92	6.72	6.41	6.05	6.20
	2	9.5	10.4	10.1	12.2	11.2	12.8	11.6	17.75	8.2	6.45	6.58	6.42	6.72	6.60
	3	9.6	10.3	10.2	10.9	10.9	12.5	11.6	17.78	8.2	6.36	6.97	6.70	6.74	6.73
	4	9.6	10.3	10.3	10.7	10.9	12.0	11.6	18.22	8.2	6.24	7.00	6.77	6.79	6.84
	5	9.9	10.3	10.4	10.8	10.8	12.0	11.5	18.25	8.2	6.19	6.93	6.62	6.84	6.89
	6.5	10.1	10.4	10.4	10.8	10.8	11.8	11.5	18.25	8.2	6.50	6.68	6.50	6.58	6.61
		Temperature °C							Cl ‰	pH	O_2 (cc/*l*)				

Table 2. Vertical distribution of plankton animals at an innermost station of Wakayama Harbor.
The numbers of plankton denote the individual number per liter.

Date	March 26							March 30						March 31						April 1			April 10		
Hour	11:00-11:10							13:00-13:07			19:00-19:07			6:00-6:08				18:00-18:03		8:00-8:07			2:00-2:07		
Depth (m)	0	1	2	3	4	5	6.5	0	3	6.5	0	3	6.5	0	3	5	6.5	0	6.5	0	3	6.5	0	3	6.5
Oithona nana	0	1	1	1	1	3	10	4	2	2	0	3	2	17	3	6	4	3	5	10	6	5	7	4	2
Acartia clausi	3	0	0	0	2	4	1	0	0	1	0	1	0	4	0	1	6	0	2	1	2	2	4	5	2
Microsetella norvegica	0	0	3	1	1	3	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Copepod nauplii	0	1	5	0	4	6	10	8	7	11	6	9	0	25	8	10	11	2	8	22	5	4	25	7	11
Paracalanus parvus	0	0	2	1	2	4	3	1	1	2	2	2	0	16	0	0	2	0	2	7	0	0	2	3	0
Evadne nordmanni	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0
Oikopleura dioica	1	0	4	0	0	0	1	0	1	1	0	0	0	2	1	0	1	0	1	1	2	0	0	2	0
Sagitta delicata	0	0	1	0	0	0	0	0	0	0	0	0	0	1	1	0	1	1	2	0	0	0	0	0	0
Polychaete larvae	0	0	2	0	9	11	19	2	8	10	6	4	1	30	3	4	10	6	7	20	7	14	17	10	6
Tintinnopsis radix	0	2	8	6	4	6	2	1	0	0	1	0	0	8	1	1	0	0	0	2	0	1	0	0	0
Favella taraikaensis	0	0	2	0	1	3	2	1	0	0	1	4	0	2	0	0	0	0	0	2	0	1	0	0	0
Noctiluca scintillans	3	2	0	1	1	1	2	2	6	1	0	8	0	6	7	1	1	6	6	5	2	2	4	3	0

Wakayama Harbor is a recently excavated small harbor in the estuary of Kinokawa River. It is very shallow, being about 8 meters in the deepest. The water is turbid and yellowish, having about 6 m in the maximum transparency. The community of plankton in this area is of the *Acartia—Oithona* type (YAMAZI 1956). The quantity of phytoplankton is very small, but the endemic species including the copepods *Oithona nana*, *Acartia clausi*, *Paracalanus parvus* and their nauplii, tunicate *Oikopleura dioica*, chaetognath *Sagitta delicata* and polychaete larvae are abundant. The following species were also observed; *Noctiluca scintillans*, *Tintinnopsis radix*, *Favella taraikaensis*, *Evadne nordmanni*, pelecypod and gastropod veligers, brachyuran zoea, *Microsetella*, *Centropages* and *Oncaea*.

Results of Observations

1. *Observation on March 25–26th, 1947*

(Figs. 2 & 3)

The diurnal changes in the number of individuals of important plankton and the hydrological data are shown in Figs. 2 and 3. Before examining the data it is necessary to show the outlines of the environmental feature, that is, tidal range, illumination, water and air temperature, chlorinity, oxygen contents, etc. Several hours in the afternoon of March 26th, the wind had blown relatively strong (less than 10 meters per second) and atmospheric pressure showed about 755 mm. Hg. However, before sunset the sky was clear away and the sun sank beyond the mountain in the distance at 6:10 p.m. After sunset the light intensity decreased suddenly and then darkened. At 9:00 p.m. the sky was, however, covered with heavy clouds and began to rain during one hour. At 10:00 good weather was restored. The stars shone in the clear sky. There appeared no moon all through the night, though it was new moon. At 6:00 a.m. the sun rose and 6:30 a.m. the sun beam shone on the surface of the sea.

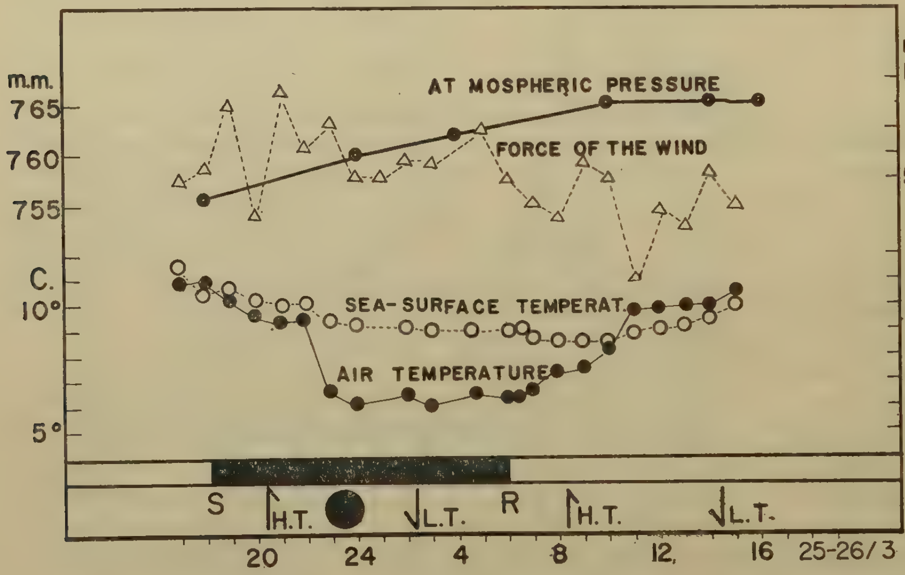

Fig. 2. The environmental conditions during the investigation on March 25–26, 1947.

The water temperature at the surface varied from 8.5°C to 12°C and the maximum value was found in the afternoon, while the minimum was in the early morning. Air temperature was highest (11°C) in the afternoon and lowest (6°C) in the midnight, and lower temperature less than 7°C was recorded from 11:00 p.m. to sunrise.

The thermocline in the under water was not found. The transparency of water was very small at all times, measuring from 3 to 4 meters. The vertical distribution of chlorinity at 11 : 00 a.m. is shown in Table 1. The chlorinity from the surface to the bottom (6.5 meters depth) varied between 13.18‰ to 18.25‰. The lower chlorinity than 14‰ was observed at the surface and one meter layer. At the under water layers the values increased towards the bottom from 17.75‰ to 18.25‰. The dissolved oxygen content was nearly uniform on all layers varying from 6.2cc to 6.9cc per liter and the content was maximum at one meter layer and decreased to the bottom. The value near the bottom was comparatively higher, between 2 and 5 meter layers. The high tides were 7 : 00 p.m. and 8 : 20 a.m. and low tides were 2 p.m. and 2 : 20 a.m.

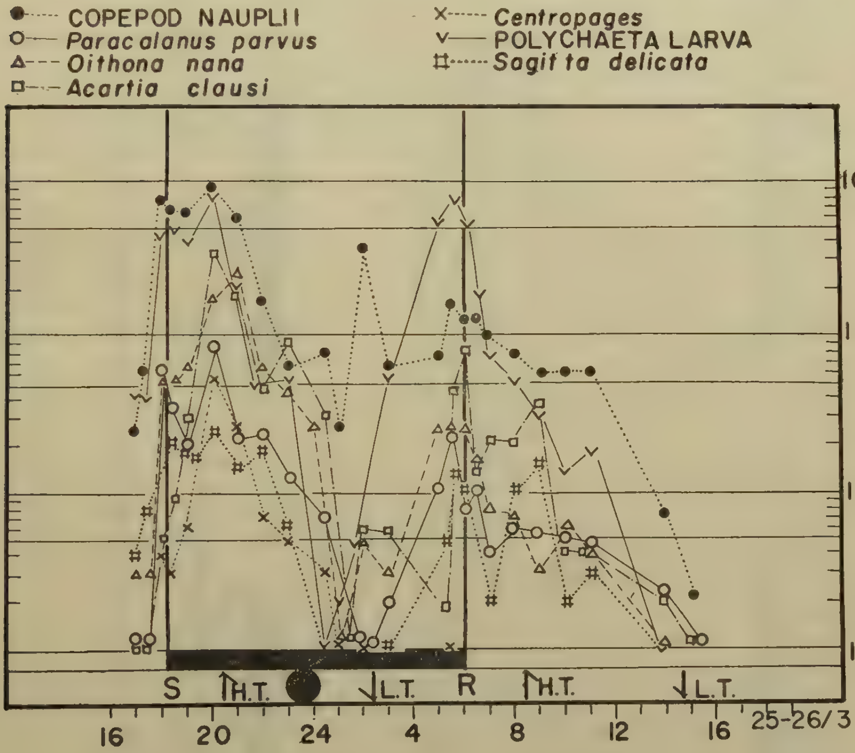

Fig. 3. The diurnal change of the number of plankton animals on the surface layer on March 25–26, 1947.

From Fig. 3 and these data it may be seen that the maximum abundance of plankton animals took place when illumination changed, that is at dusk and at dawn. The plankton showed a tendency to leave the surface layer during the midday and midnight. The copepod nauplii, polychaete larvae, the adults and copepodids of *Oithona nana*, *Acartia clausi*, *Paracalanus parvus* and *Centropages* sp. showed two times maximal occurrence, one at dusk and the other at dawn. After 8 : 00 p.m. the number of plankton suddenly decreased and from 0:00 to 3:00 a.m. reached to the minimum. *Noctiluca* and *Oikopleura dioica*, however, did not show any diurnal change in abundance. *Oncaea* was found at midnight. Many *Tintinnopsis radix*, *Favella taraikaensis* occurred abundantly before sunset and after sunrise but were very few all through the night. Pelecypod veligers occurred abundantly in the morning. *Microsetella norvegica* showed one maximal occurrence in the midnight.

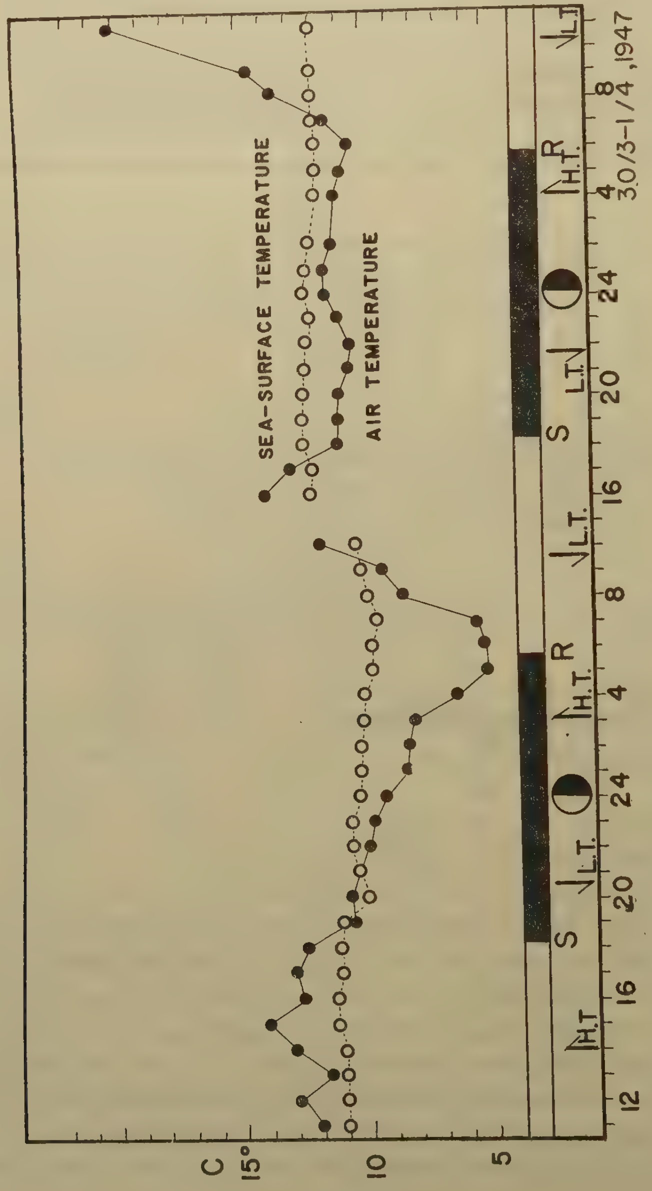

Fig. 4. The environmental conditions during the investigations on March 30–April, 1, 1947.

2. *Observation on March 30th–April 1st, 1947*

(Figs. 4–5)

During the second observation the weather was very fine and calm all day long, except several hours in the evening on March 30th when it was cloudy. The water temperature at the surface changed between 9.7°C and 11.6°C, the maximum value

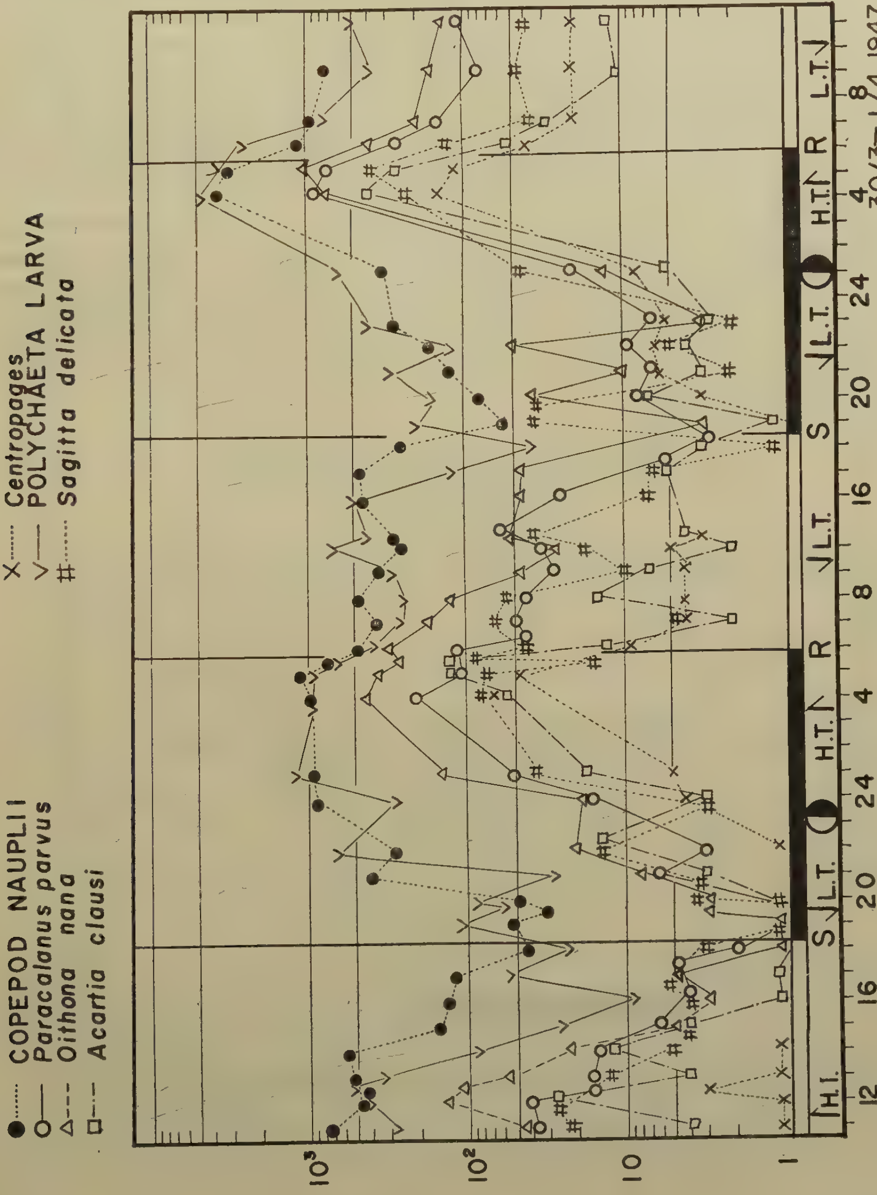

Fig. 5. The diurnal change of the number of plankton animals on the surface layer on March 30–April 1, 1947.

occurred in the afternoon. The air temperature varied largely from 5°C to 20°C and the maximum value was found in the evening. The temperature of March 31st–April 1st was higher than in the 30th–31st. As it was half moon, the tidal range was relatively smaller than that in March 25–26th. The highest tide was found at 2:00 p.m. on the 30th, 3:00 a.m. on the 31st, at 2:40 p.m. on the 31st and at 4:00 a.m. on April 1st. The lowest was at 8:00 p.m. on the 30th, at 9:40 a.m. and 9:50 p.m. on the 31st, and at 10:10 a.m. on April 1st (Fig. 4).

The diurnal changes of the plankton abundance observed in this investigation were not in agreement with the above-mentioned data on March 25–26th. Only one peak was found during the time between midnight and early morning. The minimum abundance of plankton was found during the time from the evening to the dusk, that is the first period of the change in illumination. Copepod nauplii and polychaete larvae were more abundant than the other plankton animals. The maximum abundance was in the midnight and the next was in the daytime. From the afternoon to the dusk there was minimum abundance. The other animals such as *Oithona nana*, *Paracalanus parvus*, *Acartia clausi* and *Centropages* and chaetognath *Sagitta delicata* were found most abundantly at dawn. In the morning they gradually decreased until daytime and reached to the minimum at the sunset. In a few hours after sunset small peaks were found (Fig. 5).

3. *Observation on April 9–10th, 1947*

(Figs. 6–7)

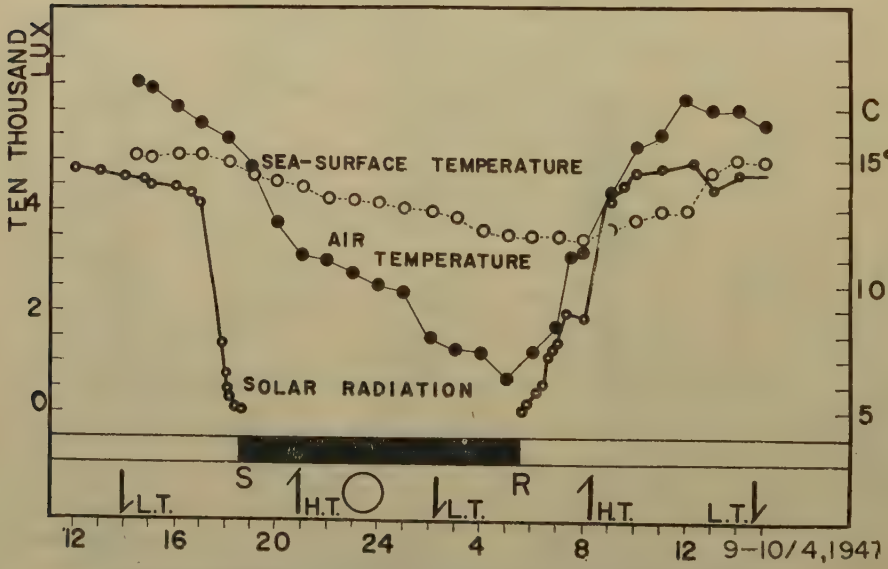

Fig. 6. The enviromental conditions during the investigation on April 9–10, 1947.

The third observation on the diurnal change of plankton animals at the surface was made during the period of full moon in April. Every hourly collection was begun at 3:00 p.m. and stopped at 3:00 p.m. on the next day. The weather was very fine and the surface water was also very calm all day long. The sun was bright in the daytime and the bright full moon shone in the clear sky at night. As shown in Fig. 6 the sun's illumination in the daytime was 40,000–50,000 Lux and at 5:00 p.m. it decreased and at 6:46 p.m. the twilight faded away. Then the water temperature gradually decreased and attained the minimum at 8:00 a.m. on the next day. The air temperature also decreased and the minimum value 6°C was found at 5:00 a.m. The sky lightened at 5:00. The sun rose at 5:44 a.m. and the illumination increased gradually, while at 8:00 a.m. the sun was covered with light clouds. In the daytime, however, it was quite bright.

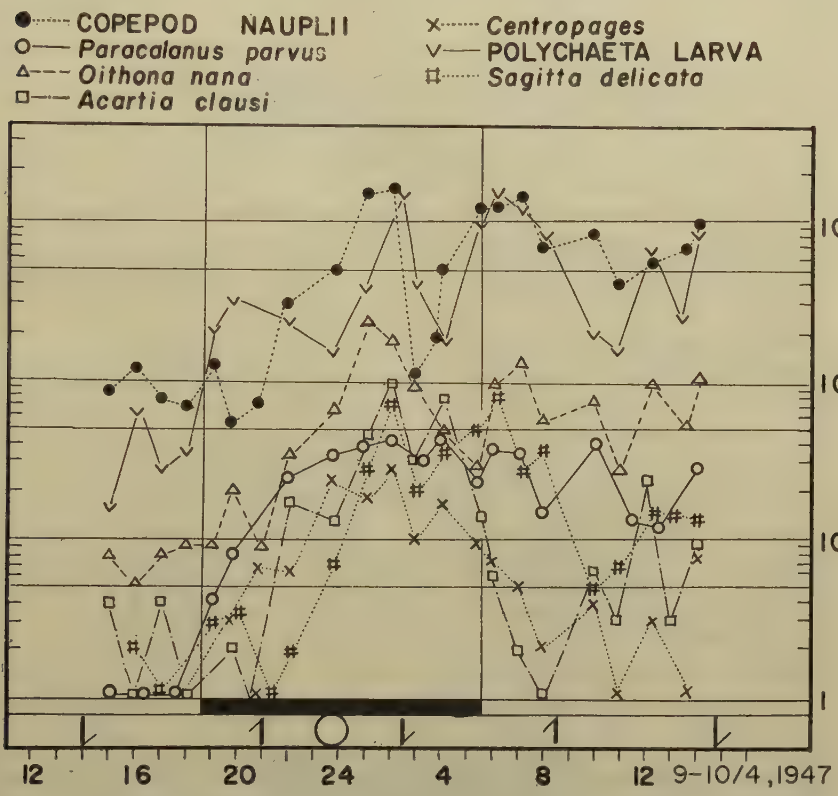

Fig. 7. Diurnal change in the number of plankton animals on the surface layer on April 9–10, 1947.

Copepod nauplii and polychaete larvae abundantly occurred at 3 : 00 a.m. and from 6 : 00 to 8 : 00 on the 10th, as in the case of the former observation. In the afternoon they were very rare, although they crowded more abundantly than the other animal plankton, such as *Oithona nana*, *Acartia clausi*, *Paracalanus parvus* and *Sagitta delicata*.

The latter four were very few in the evening while after sunset they gradually increased and attained the maximum in the midnight and they remained still rather abundantly at the surface to the next daytime.

4. *Summary of Observations on Diurnal Change*

(Figs. 8–12)

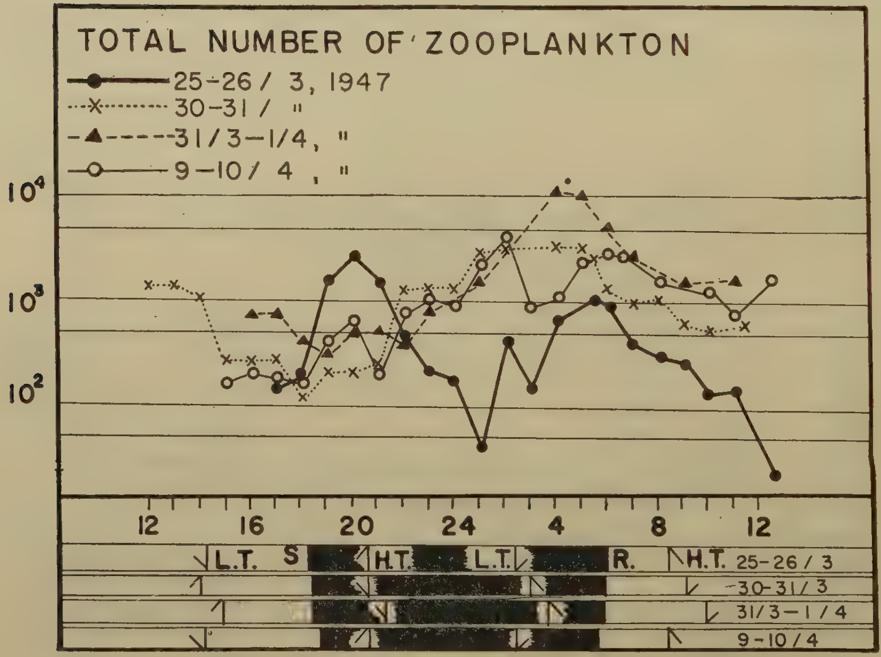

Fig. 8. Total number of zooplankton per 10 liters at the surface layer during the investigations.

The diurnal changes in the abundance of plankton animals at the surface water observed three times at the same station are summarized in the figures. Fig. 8 shows the diurnal change of the abundance of total number of animals. In Figs. 9–12 are given the diurnal changes of individual species of animal plankton.

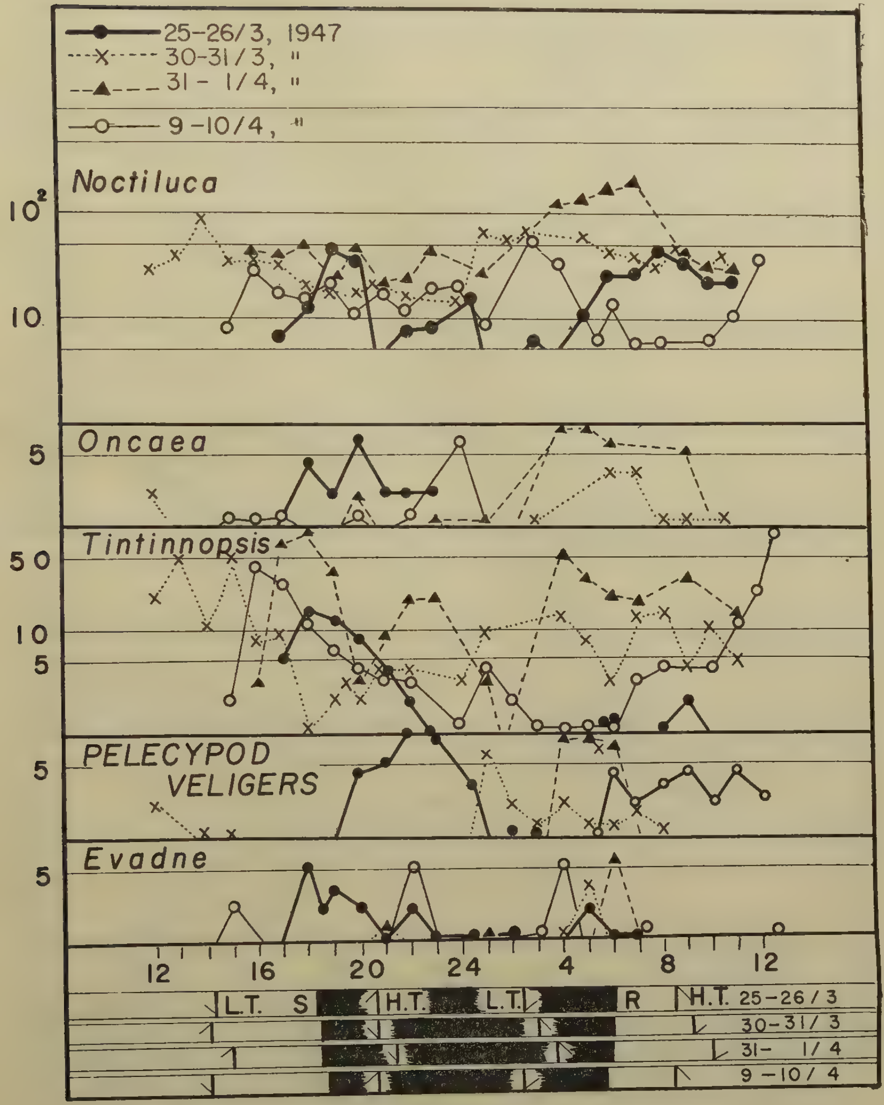

Fig. 9. Diurnal change of number in respective species (1).

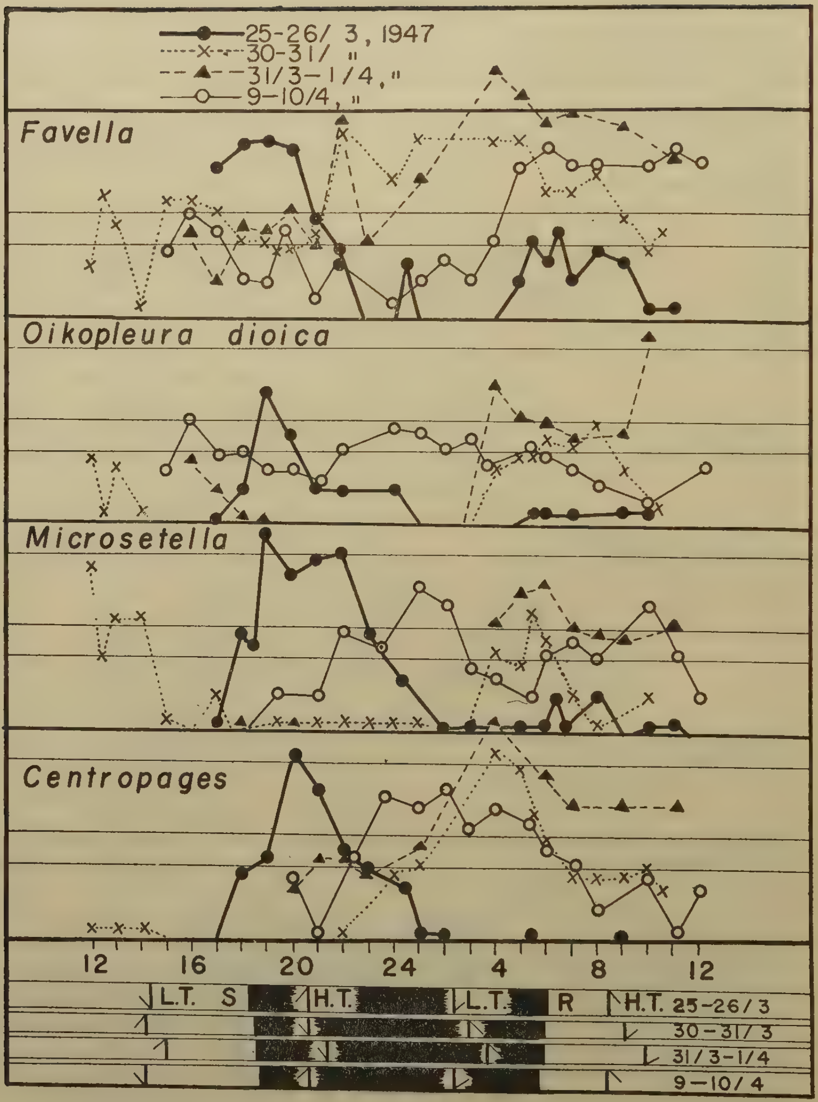

Fig. 10. Diurnal change of number in respective species (2).

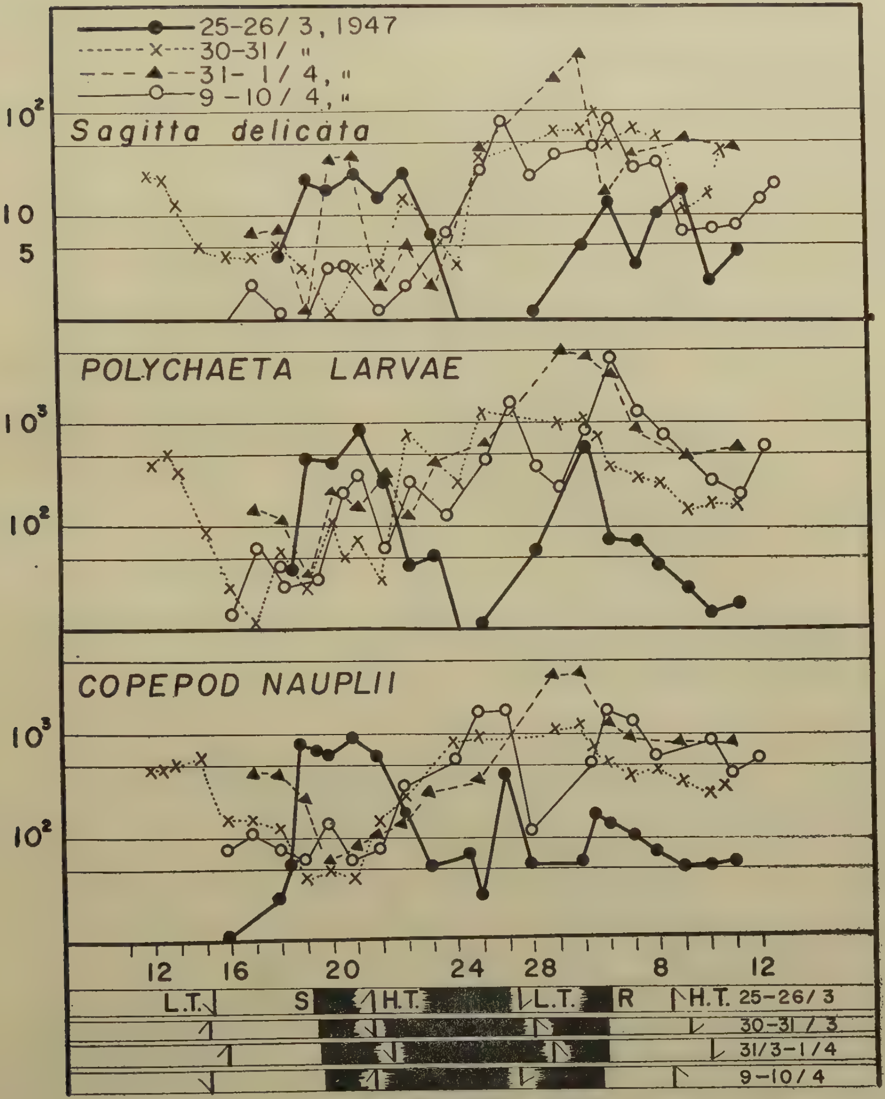

Fig. 11. Diurnal change of number in respective species (3).

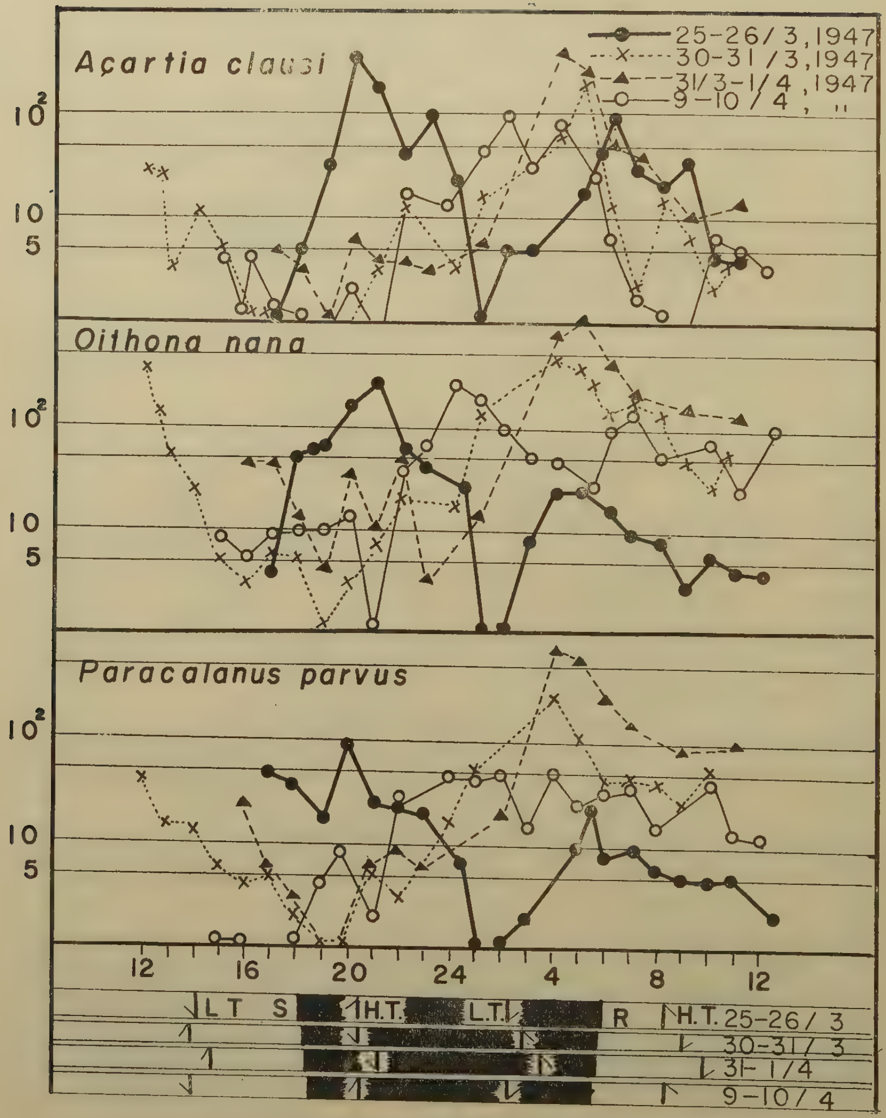

Fig. 12. Diurnal change of number in respective species (4).

Discussion and Conclusion

In these observations it is clear that there are diurnal variations in the abundance of each species of plankton animals in sea water, and it is not only the differences of the type of the diurnal vertical migration of animal themselves by the intensity of light, but also the diurnal differences of the enviromental conditions. The sea water is always moving more or less so that the plankton in it is influenced by water movement. In inlet waters the movement of water masses is forced by mechanical factors such as tidal exchange and wind force and the quantity of plankton containing within them in some particular area is not always constant. In such innermost area of brackish water, the plankton animals of pure saline type are generally sparse (YAMAZI 1956). Therefore, it seems that more saline forms may be transported with the reversible current flows at flood and ebb tides.

However, there are actually various cases in diurnal change.

1. Some species are abundant at the surface during night, while very few during daytime, as in examples of *Oncaea* sp. and *Microsetella*.
2. Some species show a tendency to rise up to the surface at dusk or dawn and to descend down to the depth at noon and night, as in examples of *Paracalanus parvus*, *Oithona nana*, *Acartia clausi*, *Sagitta delicata*, *Evadne*, *Centropages* and polychaete larvae.
3. Some species appear abundantly at the surface at dawn and morning, and sink quickly at night, as in examples of *Tintinnopsis radix* and *Favella taraikaensis*.
4. Some species are evenly distributed all day long and show no marked diurnal migration at all, as in examples of *Oikopleura dioica* and *Noctiluca scintillans*.

The "twilight migration" after KIKUCHI (1930), that the plankton animals ascend towards the surface at dawn and evening twilight and descend both in daytime and midnight, was not observed in the present studies as in the results obtained by MOTODA (1953). It is reported that the diurnal movement of plankton animals is one of the most striking characteristics and the source of the effect is the light intensity. In the present studies, generally speaking, the diurnal migration takes place in accordance with the change of light intensities. But it cannot be said that all the factors governing the diurnal change are the light intensities.

The relation between the abundance of plankton at the surface and the intensity of the moon light could not be clarified in the present studies which were performed during the three different lunar ages, new-moon, half-moon and full-moon. And also the difference in the abundance of plankton during daytime in the fine and cloudy weather in daytime is not clear. The marked diurnal change observed on March 25–26th may be due to the mechanical forces caused by strong wind and extreme range of high- or low-tide on a day of new moon.

REFERENCES

CLARKE, G. L. 1933. Diurnal migration of plankton in the Gulf of Maine and its correlation with changes in submarine irradiation. Biol. Bull., 65 (3), pp. 402–436.

——— 1934a. Further observations on thu diurnal migration of copepods in the Gulf of Maine. Ibid., 67 (3), pp. 432–455.

——— 1934b. The diurnal migration of copepods in St. Georges Harbor, Bermuda. Ibid., 67 (3), pp. 456–460.

JOHNSON, W. H. 1938. The effect of light on the vertical movements of *Acartia clausi* (Giesbrecht). Ibid., 75 (1), pp. 106–118.

KAWARADA, Y. 1952. On the daily change of plankton at the inner part of Sagami Bay. Rep. Central Meteor. Obs., 2 (4), pp. 333–336 (In Japanese).

KIKUCHI, K. 1930. A comparison of the diurnal migration of plankton in eight Japanese lakes. Mem. Coll. Sci. Kyoto Imp. Univ., Ser. B. 5 (1), pp. 27–74.

——— 1938. Studies on the vertical distribution of the plankton Crustacea. II. The reversal of phototropic and geotropic signs of the plankton Crustacea with reference to the vertical movement. Rec. Oceanogr. Works Jap., 10 (1), pp. 17–41.

——— 1939. Vertical distribution of zooplankton. Zool. Mag., 51 (5), pp. 302–312 (In Japanese).

MARUMO, R. and Y. KAWARADA 1951. On the diurnal variation of planktological conditions at the center of Sagami Bay. I∼III. Rep. Central Meteor. Obs., 2 (1), pp. 33–42, 2 (2), pp. 159–162.

MOTODA, S. 1953. Observation on diurnal migration of plankton crustaceans in Lake Shikotsu, Hokkaido, and Tsugarujuni, Aomori, and some experiments on photo- and geotropism. Mem. Fac. Fish., Hokkaido Univ., 1 (1), pp. 1–56.

MOTODA, S. and T. ISHIDA, 1950. An observation on the diurnal migration of plankton crustaceans at Lake Abashiri, Hokkaido, in summer of 1947. Sci. Rec. Hokkaido Fish. Hatchery, Sapporo, 5 (2), pp. 1–8 (In Japanese).

MOTODA, S. and S. SATO 1949. A brief observation on the diurnal migration of marine zooplankton off shiretoko, Hokkaido. Sci. Pap., Hokkaido Fish. Res. Inst., 2, pp. 72–77.

RUSSELL, F. S. 1925–1934. The vertical distribution of marine macroplankton. Jour. Mar. Biol. Ass., 13 (4), 14 (2 and 3), 15 (1, 2 and 3), 16 (2), 17 (2 and 3) and 19 (2).

YAMAZI, I. 1956. Plankton investigation in inlet waters along the coast of Japan. XIX. Publ. Seto Mar. Biol. Lab., 5 (2), pp. 25–64.

TERRESTRIAL FAUNA OF KASHIMA ISLETS IN THE BAY OF TANABE, WAKAYAMA PREFECTURE[1]

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The Islets of Kashima are located in the Bay of Tanabe, and are about 1 km apart from the mainland, Kii Peninsula, and 3.5 km east of the Seto Marine Biological Laboratory at Shirahama, Wakayama Prefecture. The Islets are actually formed of two small islets, joined by natural bridge of rocks. These two islets are about 700 m and 300 m round respectively. Both of them are less than 20 m at the highest, and they are constituted of the Tertiary rocks. They are covered with primeval dense forests which are composed of *Rhus silvestris*, *Ilex integra*, *Machilus Thunbergii*, *Daphniphyllum Teijsmannii*, *Camellia japonica*, *Cinnamomum japonicum*, *Prunus Zippeliana*, etc. Owing to the abundant flora which contains some subtropical plants, the islets have been designated as a natural monument. The flora have been well surveyed and 160 species of higher plants have been recorded previously. But, hitherto few have been known of the terrestrial fauna except the land snails. This is the reason why the present investigation has been undertaken, and the writer had an opportunity to collect and investigate the land animals of these islets from 1 to 5 June, 1956, through the good offices of Dr. Huzio UTINOMI of the Seto Marine Biological Laboratory.

Subterranean animals were collected from forest soil within the depth of about 2.5 cm by using Berlese funnels, and the soil was of so-called mull type and showed acidity of pH 5.8 on an average. Drosophilids are caught by banana-trapping, and other animals were collected by searching the litter layers of the forest and the sea-shore drifts, and by peeling the bark of trees.

The collected animals were classified into 226 species, 193 genera, 123 families, and 31 orders belonging to 4 phyla, as shown in Table 1.

The findings of such subtropical and noticeable species as *Tornatellides boeningi inexpectus*, *Philoscia muscorum*, *Kashimachelifer cinnamomeus*, *Otocryptops rubiginosus kasimensis*, *Duolandrevus coulonianus*, *Laius asahinai*, etc. are of much interest from the zoogeographical view-point.

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1) Contributions from the Seto Marine Biological Laboratory, No. 304.

Publl. Seto Mar. Biol. Lab., VI (2), 1957. (Article 14)

Table 1.

	Class	Order	Family	Genus	Species
Annelida	1	2	3	4	4
Mollusca	1	1	8	13	14
Arthropoda	6	25	108	172	204
Crustacea		*2*	*4*	*5*	*5*
Arachnida		*4*	*35*	*48*	*56*
Diplopoda		*3*	*3*	*3*	*3*
Symphyla		*1*	*2*	*2*	*2*
Chilopoda		*3*	*6*	*8*	*9*
Insecta		*12*	*58*	*106*	*129*
Vertebrata	2	3	4	4	4
Total	10	31	123	193	226

Acknowledgments

The collected animals were sent to specialists for identification, except the molluscs which were referred to the description of Dr. Tokubei KURODA[1] and such groups familiar to the writer as pseudoscorpions, mites, etc. Consequently, the writer is greatly indebted to many following persons who identified the present materials:

Dr. Hideji YAMAGUCHI, Hokkaido Gakugei University, Hakodate (Archioligochaeta); Dr. Shinryo OHFUCHI, Tokyo Agricultural University (Neoligochaeta); Dr. Huzio UTINOMI, Seto Marine Biological Laboratory, Shirahama (Crustacea); Mr. Takeo YAGINUMA, Otemon Gakuin, Osaka (Araneina); Dr. Seisho SUZUKI, Hiroshima University (Opiliones); Mr. Yasunori MIYOSI, Matsuyama Kita High School (Millipedes); Dr. Ryozo YOSII, Kyoto University (Collembola); Dr. Mikio KUROSAWA, Nihon Noyaku Produc. Co., Tokyo (Thysanoptera); Dr. Tamotsu ISHIHARA (Heteroptera and Orthoptera), Mr. Mutsuo MIYATAKE and Mr. Sadanari HISAMATSU (Coleoptera), Mr. Susumu UEDA (Wasp), Mr. Fumihiko TAKECHI (Formicidae in part), and Mr. Masayoshi OHUE (Collembola in part), Ehime University; Mr. Kei OKAMOTO, Heiwa Middle School, Kochi Prefecture (Formicidae); Mr. Katsura MORIMOTO, Kyushu University (Curculionidae in part); Dr. Toyohi OKADA, Tokyo Metropolitan University (Drosophila). Dr. Tadashige HABE of Kyushu University kindly inserted corrections regarding the scientific names of molluscs.

The writer wishes to express hearty thanks to Dr. H. UTINOMI, Mr. Torao YAMAMOTO and other members of the Seto Marine Biological Laboratory, Mr. Shin GOTO of the Ena Middle School, Wakayama Pref., and the members of the protection committee of the natural monument of Tanabe City for their kind co-operations in the

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1) KURODA, T., Venus, 13 (5/8) : 313-316, 1944.

course of the present survey. His thanks are also due to Dr. Takeo Ito of Ehime University who was kind enough to read the manuscript of this report.

LIST OF THE LAND ANIMALS OF KASHIMA ISLETS1)

Phylum ANNELIDA

Class Oligochaeta

Order Neoligochaeta

Family Megascolecidae

Pheretima servinus Hatai et Ohfuchi モリミミズ 2 *exs*

Family Lumbricidae

Bimastus sp. (similar to *B. parvus*, but smaller) フクロナシミミズの1種 3 *exs*
Eisenia foetida (Savigny) シマミミズ 8 *exs*
Eisenia or *Pheretima* sp. (juvenile) 7 *exs*

Order Archioligochaeta

Family Enchitraeidae

Pachydrilus? sp. ヒメミミズの1種 about 300 *exs*

Phylum MOLLUSCA

Class Gastropoda

Order Stylommatophora

Family Elasmatidae

Tornatellides boeningi inexpectus (Pilsbry) ノミガイ2)

Family Clausiliidae

Tyrannophaedusa plicilabris (A. Adams) コスジギセル abundant
Reinia variegata (A. Adams) ヒロクチコギセル common

Family Achatinidae

Allopeas pyrgula Schmacker et Boettger ホソオカチョウジガイ abundant

Family Discidae

Punctum rota Pilsbry et Hirase クルマナタネ

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1) Abbr. *a*=adult, *s*=subadult, *y*=immature, *deut*=deutonymph, *prot*=protonymph, *trit*=tritonymph.

2) Subtropical species, and distributed in S. Kyushu and Izu-hichi-to Islands.

Family Helixarionidae

Parakaliella crenulata (GUDE) カサキビ
P. habei (KURODA) ハベキビ
Parasitara pallida (PILSBRY) ウスイロシタラ
Nipponochlamys semisericata (?) (PILSBRY) キヌツヤベッコウ

Family Camaenidae

Satsuma japonica peculiaria (A. ADAMS) ムロマイマイ abundant

Family Bradybaenidae

Euhadra gulicki sigeonis KURODA シゲオマイマイ abundant
Bradybaena similaris (FÉRUSSAC) オナジマイマイ abundant
Acusta sieboldiana (PFEIFFER) ウスカワマイマイ common

Family Streptaxidae

Guella (*Sinoennea*) *iwakawa* (PILSBRY) タワラガイ abundant

Phylum ARTHROPODA

Class CRUSTACEA

Order Amphipoda

Family Talitridae

Orchestia platensis KRÖYER ヒメハマトビムシ 4♂, 15♀, 3*s*♂, 14*s*♀, 89*y*

Order Isopoda

Family Porcellionidae

Porcellio scaber LATREILLE ワラジムシ 2♀, 1*y*

Family Oniscidae

Alloniscus perconvexus (DANA) タマワラジムシ 3♀
Philoscia muscorum (SCOPOLI) BUNDE-LUND カナエムシの1種[1] 2♂, 11♀

Family Armadillididae

Cubalis dorsalis (IWAMOTO) セグロコシビロテマリムシ 99*a*, 472*y*

Class ARACHNIDA

Order Pseudoscorpionidea

Family Chthoniidae

Mundochthonius japonicus CHAMBERLIN メクラヒメツチカニムシ 29♂, 12♀, 1 *trit*
Tyrannochthonius dogoensis MORIKAWA ムネトゲツチカニムシ 1♂, 1♀

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[1] Recorded in Japan for the first time.

Family Neobisiidae

Neobisium (*Parobisium*) sp. A. コケカニムシの1種 2 *trit*, 26 *deut*, 2 *prot*

Family Chernetidae

Toxochernes japonicus MORIKAWA モリケルネス 10♂, 21♀, 7 *trit*, 26 *deut*, 3 *prot*

Family Cheliferidae

Kashimachelifer cinnamomeus MORIKAWA カシマイボテカニムシ1) 2♂, 7♀

Order Araneina

Family Ctenizidae

Ummidia fragaria (DÖNITZ) キノボリトタテグモ 1*y*♀

Family Segestriidae

Ariadna lateralis (KARSCH) ミヤグモ 1*s*♀

Family Teridiidae

Teridion crassipes (BOESENBERG et STRAND) コノハヒメグモ 1♀
Th. sterninotatum BOESENBERG et STRAND ムナボシヒメグモ 1*s*♀
Th. japonicum BOESENBERG et STRAND ヒメグモ 1♂, 1*s*♀
Th. sp. ヒメグモの1種 1 *ex*
Dipoena sp. ミジングモの1種 1 *ex*

Family Micryphantidae

Oedothorax sp. アカムネグモの1種 3 *exs*
Gen. spp. コサラグモ科の数種 abundant

Family Agriopidae

Neoscona subpullata (BOESENBERG et STRAND) ヘリジロオニグモ 2♀
N. mellotteei SIMON ワキグロサツマノミダマシ 1*y*♀
Leucauge sp. シロガネグモの1種 1 *ex*

Family Lycosidae

Pirata piratoides (BOESENBERG et STRAND) ヒナドクグモ 1♀
Lycosa spp. ドクグモの数種 abundant

Family Oxyopidae

Oxyopes sertatus L. KOCH ササグモ 1*s*♀

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1) Found under the bark of tree (*Cinnamomum japonicum*), and described in Zool. Mag. (Jap.) 66 (10) : 399-402, 1957.

Family Agelenidae

Agelena sp. クサグモの1種 1 *ex*
Caelothes sp. ヤチグモの1種 1 *ex*
Tegenaria sp. タナグモの1種 1 *ex*

Family Thomisidae

Xysticus ephippiatus Simon ヤミイロカニグモ 2♂

Family Salticidae

Myrmarachne japonica (Karsch) アカアリグモ 1*s*♀
Evarcha albaria (L. Koch) マミジロハエトリ 1♂, 1*s*♀

Family Clubionidae

Itatsina praticola (Boesenberg et Strand) イタチグモ 1*s*♀, many *y*♀
Clubiona sp. フクログモの1種 1 *ex*

Family Heteropodidae

Heteropoda forcipata (Karsch) コアシダカグモ 1 *s*♀, 2*y*♀

Family Ctenidae

Anahita fauna Karsch シボグモ 1♀, 1*s*♀

Order Opiliones

Family Phalangodidae

Pseudobiantes japonicus Hirst カマキリザトウムシ 6 *exs* 〔lives in the dark place (troglophilous animal)〕

Family Phalangiidae

Gagrella japonica Roewer ヒトハリザトウムシ 5 *exs* (maritime animal)

Order Acarina

Family Macrochelidae

Macrocheles sp. 1 マエツメナシダニの1種 14♂, 22♀
M. sp. 2 10♀
M. sp. 3 1♀
Macrochelidae? sp. 18♂, 98♀, 141*y*

Family Gamasolaelaptidae

Gen. sp. ヨコスジムシダニ科の1種 1♀

Family Parasitidae

Parasitus sp. キセイダニの1種 10♂, 20♀

Family Neoparasitidae

Gen. sp. 1 シンキセイダニ科の1種 7♂, 26♀
Gen. sp. 2 1♀

Family Calyptostomidae

Gen. ? sp. サヤアゴダニ科の1種? 1♀

Family Cunaxidae

Cunaxas sp. ヒメテングダニの1種 1*s*♀

Family Labidostomidae

Labidostoma sp. ヨロイダニの1種 2♀

Family Acaridae

Rhizoglyphus ? sp. ネダニの1種? 4 *exs*

Family Nanhermanniidae

Nanhermannia sp. pc フクロハラヤマダニ 1 *ex*

Family Epilohmanniidae

Epilohmannia sp. ja ヨコミゾヤマダニ 1 *ex*

Family Lohmanniidae

Torpacarus sp. ka ツツハラヤマダニ 106*a*, 116*y*

Family Hypochthoniidae

Gen. ? sp. チカノヤマダニ科の1種 1 *ex*

Family Camisiidae

Gen. (closely akin to *Heminothrus*) sp. セクボヤマダニ科の1種 1 *ex*
Nothrus sp. pb セクボヤマダニ 5 *exs*

Family Hermanniidae

Gen. ? sp. ナカダカヤマダニ科の1種 3 *exs*

Family Eremaeidae

Eremaeus sp. ke ノロモリダニ 1 *ex*

Family Phthyracaridae

Phthyracarus sp. hz ハコガメダニ 12*a*, 11*y*

Oribotritia sp. pd ミツズメハコガメダニ 8 *exs*
O.? sp. hh 2 *exs*
Pseudotritia sp. sh ホソハコガメダニ 1 *ex*

Class DIPLOPODA

Order Polyxenomorpha

Family Polyxenidae

Monographis takakuwai MIYOSI ハイボクフサヤスデ 10 *exs* (abundant on the ground and trees)

Order Polydesmoidea

Family Strongylosomatidae

Ndyopus patrioticus patrioticus (ATTEMS) ヤマトアカヤスデ 2♂, 6♀

Order Juliformia

Family Julidae

Fusiulus sp. ヒメヤスデの1種 2♂, 5*y*

Class SYMPHYLA

Order Symphyla

Family Scolopendrellidae

Symphylella vulgaris HANSEN ヤサコムカデ 22 *exs*

Family Scutigerellidae

Hanseniella sp.? ナミコムカデ 1 *ex*

Class CHILOPODA

Order Scolopendromorpha

Family Scolopendridae

Scolopendra subspinipes japonica L. KOCH アオズムカデ 4 *exs*

Family Cryptopidae

Otocryptops rubiginosus (L. KOCH) セスジアカムカデ 1 *ex*
O. rubiginosus kashimensis MIYOSI カシマセスジアカムカデ1) 1♂, 1♀

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1) Newly found and described by Y. MIYOSHI in Zool. Mag. (Jap.) 66 (6) : 256–257, 1959.

Order Geophilomorpha

Family Schendylidae

Momophilus serratus Takakuwa モモジムカデ 2 *exs*
Thalthybius tenuicolis Takakuwa サキブトジムカデ 3 *exs*

Family Mecistocephalidae

Mecistocephalus fenestratus Verhoeff マドナガズジムカデ 5 *exs*
M. marmoratus Verhoeff ブチナガズジムカデ 5♂, 9♀

Family Geophilidae

Pleurogeophilus sp. ツチムカデの1種 12*y*

Order Lithobiomorpha

Family Lithobiidae

Bothropolys imaharensis Verhoeff イマハルイッスンムカデ 15 *exs*
Monotarsobius ramulosus Takakuwa ランザンヒトフシムカデ 12 *exs*

Class Insecta

Order Thysanura

Family Japygidae

Japyx japonicus Enderline ヤマトハサミコムシ 7 *exs*

Order Collembola

Family Hypogastruridae

Hypogastrura communis exillis Yosii ムラサキトビムシ 1*y*

Family Neanuridae

Neanura (Propeanura) mandarina Yosii オオアカイボトビムシ 2*y*
N. sp. 1*y*
Metanura sancti-sebastiani Yosii 1*a*

Family Brachystomellidae

Odonthella sp. 2*y*

Family Onychiuridae

Onychiurus yagii Miyoshi ヤギトビムシモドキ 8*a*
O. flavescens Yosii 5*a*, 4*y*
O. spp. (containing *O. uenoi* Yosii ?) 82*y*

Family Isotomidae

Folsomia fimetaria LINNÉ? フオルソムトビムシ 3*a*

Isotoma trispinata MACGILLIVRAY ミドリトビムシ 4*a*

I. sp. 83*y*

Isotomiella minor (SCHAFFERS) 1*y*

Family Achorutidae

Pseudoachorutes sp. 3*a*

Family Entomobryidae

Sinella umesaoi YOSII? 1*y*

Homidia sauteri BÖRNER ザウテルアヤトビムシ 7*a*, 7*y*

Order Orthoptera

Family Gryllidae

Duolandrevus coulonianus DE SAUSSURE クチキコオロギ 4*y* (subtropical species)

Family Mogoplistidae

Ornebius bimaculatus SHIRAKI イソカネタタキ 2*s*♀, 2*y* (subtropical species)

Family Phyllodromiidae

Phyllodromyia lituricollis WALKER モリチャバネゴキブリ 1♂, 2♀, 2*y*

Ph. kumamotonis SHIRAKI スカシバチビゴキブリ 1♂, 3*y*

Order Dermaptera

Family Anisolabiidae

Anisolabis maritima BORELLI ハサミムシ 14*y*

Order Isoptera

Family Termitidae

Coptotermes formosanus SHIRAKI イエシロアリ 5♃

Order Thysanoptera

Family Thripidae

Hoplothrips flavipes (BAGNALL) クチキクダアザミウマ 3 *exs*

Order Hemiptera

Family Cicadidae

Terpnosia vacua OLIVIER ハルゼミ abundant

Family Miridae

Deraeocoris rufus DISTANT 1 *ex*

Family Reduviidae

Sphedanolestes impressicollis STÅL シマサシガメ 1 *ex*

Family Coreidae

Hygia opaca UHLER ツマキヘリカメムシ 8 *exs*

Family Pentatomidae

Megymenum gracilicorne DALLAS ノコギリカメムシ 1 *ex*
Glaucias subpunctatus WALKER ツヤアオカメムシ 1 *ex*
Nezara antenuata SCOTT アオクサカメムシ 1 *ex*

Family Thyreocoridae

Adrisa magna (UHLER) ヨコズナツチカメムシ[1]

Order Neuroptera

Family Chrysopidae

Chrysopa sp. クサカゲロウの1種 1 *ex*

Order Lepidoptera

Family Geometridae

Archanna jaguararia GUÉNÉE ヒョウモンエダシャク 3 *exs*

Family Pieridae

Eurema hecabe LINNÉ キチョウ 5 *exs*
Pieris rapae crucivora BOISDUVAL モンシロチョウ 6 *exs*

Family Papilionidae

Graphium sarpedon nipponus FRUHSTORFER アオスジアゲハ 2 *exs*

Family Satyridae

Ypthima argus BUTLER ヒメウラナミジャノメ 2 *exs*

Order Coleoptera

Family Paussidae

Eustra plagiata japonica BATES エグリゴミムシ 3 *exs*

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1) After GOTO, S., Nanki-Seibutsu II (2) : 95, 1950.

Family Harpalidae

Tachys sericans Bates ウスオビコミズギワゴミムシ 2 *exs*
Platymetopus flavilabris corrosus Bates 1 *ex*
Calathus (*Crepidactyla*) *nitidus* Motschulsky オオクロツヤヒラタゴミムシ 3 *exs*
C. (*Pristodactyla*) *dulcigradus* Bates ヒメツヤヒラタゴミムシ 1 *ex*

Family Staphylinidae

Osorius taurus Sharp ツノフトツツハネカクシ 2 *exs*
Domene crassicornis Sharp オオマルズハネカクシ 2 *exs*
Lathrobium partitum Sharp サキアカバナガハネカクシ 3 *exs*
Philonthus rectangulus Sharp カクコガシラハネカクシ 7 *exs*
Ph. sp. カクコガシラハネカクシの1種 1 *ex*
Cafius vestitus Sharp アバタウミベハネカクシ 1 *ex*
Phucobius simulator Sharp ウミベアカバハネカクシ 15 *exs*
Ischnopoda (*Microdota*) sp. 1 *ex*
Thamiaraea japonica Cameron 3 *exs*
Amarochara (*Amarochara*) sp. 1 *ex*

Family Hydrophilidae

Cercyon sharpi Harold フチトリケシガムシの1種 4 *exs*
Megasternum gibbulum Motschulsky マグソガムシの1種 2 *exs*

Family Lampyridae

Psilocladus ruficollis Kiesenwetter ムネクリイロボタル 1 *ex*

Family Dasytidae

Laius asahinai Nakane イソジョウカイモドキ 1 *ex* (interesting species and live in the maritime drifts)

Family Nitidulidae

Haptoncus ocularis Fairmaire ケシキスイの1種 5 *exs*

Family Coccinelidae

Epilachna sparsa orientalis Dieke ニジュウヤホシテントウ 1 *ex*
Hyperaspis japonica Crotch ウスフタホシテントウ 1 *ex*
Scymnus (*Pullus*) *hilaris* Motschulsky 2 *exs*
Serangium japonicum Chapin 1 *ex*
Amida tricolor Harold アミダテントウ 2 *exs*

Family Elateridae

Dicronychus (*Platynchus*) *adjutor* Candeze アカアシハナコメツキ 1 *ex*

Family Dermestidae

Trinodes rufescens Reitter チビケカツオブシムシ 1 *ex*
Gastrallus laevigatus Olivier 1 *ex*

Family Ciidae

Cis (*Hadraule*) *bifasciatus* Reitter フタオビツツキノコムシ 2 *exs*

Family Sphindidae

Aspidiphorus sp. ヒメキノコムシの1種 1 *ex*

Family Tenebrionidae

Idisia ornata Pascoe ハマヒョウタンゴミムシダマシ 1 *ex*
Micropedinus algae Lewis ホソハマベゴミムシダマシ 23 *exs*
M. pallidipennis Lewis ヒメホソハマベゴミムシダマシ 1 *ex*

Family Alleculidae

Hymenaria rufipennis Marseul アカハネヒメクチキムシ 1 *ex*

Family Curculionidae

Trachyphloeosoma sp. A 1 *ex*
T. sp. B 1 *ex*
Curculio funebris Roelofs 2 *exs*
Myosides seriehispidus Roelofs チビヒョウタンゾウムシ 8 *exs*
Phyllobius brevitarsis Kono コヒゲボソゾウムシ 1 *ex*
Stenoscelis gracilitarsis Wollaston 5 *exs*
Demimaea circula Roelofs マルモンササラゾウムシ 2 *exs*
Cryptorrhynchidius insidiosus Roelofs マツシラホシゾウムシ 3 *exs*
Acalles sp. 8 *exs*
Gen. sp. (Gen. & sp. nov. belongings to new Tribe) メクラツヤゾウムシ 10 *exs*

Family Ipidae (Scolytidae)

Xyleborus rubicollis Eichhoff アカクビキクイムシ 1 *ex*
Cryphalus sp. コキクイムシの1種 2 *exs*

Family Trogidae

Trox opacotuberculatus Motschulsky ヒメコブスジコガネ 1 *ex*

Family Scarabaeidae

Panelus parvulus Waterhouse マメガムシガタコガネ 1 *ex*
Cetonia pilifera Motschulsky ハナムグリ 1 *ex*

Order Hymenoptera

Family Ichneumonidae

Diplozon laetatorius (FABRICIUS) アカハラヒラタアブヤドリバチ 1 *ex*

Family Vespidae

Polistes japonicus fadwigae DALLA TORRE セグロアシナガバチ 1 *ex*
Vespa mandarina SMITH スズメバチ 3 *exs*

Family Crabronidae

Lestica (=*Crabro*) sp. ギンクチバチの1種 1 *ex*

Family Halictidae

Halictus sp. コハナバチの1種 4 *exs*

Family Formicidae

Amblyopone silvestrii WHEELER ノコギリハリアリ 4☿
Sysphincta watasei WHEELER ワタセハリアリ 10☿
S. sp. 1☿
Ponera scabra WHEELER テラニシハリアリ 5☿
P. sp. 1☿
Pheidole pieli SANTSCHI オオズアカアリの1種 13♃, 98☿
Crematogaster laboriosa SMITH? トビイロシリアゲアリ 3☿
C. sordidula osakensis FOREL キイロシリアゲアリ 147☿
Myrmecina graminicola nipponica WHEELER カドフシアリ 7☿
Pristomyrmex pungens MAYER アミメアリ 3☿
Olygomyrmex sauteri FOREL コツノアリ 4♃, 37☿
Strumigenis lewisi CAMERON ウロコアリ 1♀, 6☿
Smithistrum sp. 2☿
Polyrhachis hippomanes moesta EMERY チクシトゲアリ 1☿
Paratrechina flavipes SMITH アメイロアリ 1♀, 86☿
Lasius niger LINNÉ? トビイロケアリ 10☿
Formica fusca japonica MOTSCHULSKY クロヤマアリ 51☿
Camponotus (*Camponotus*) sp. オオアリの1種 1☿

Order Diptera

Family Culicidae

Aedes albopictus SKUSE ヒトスジシマカ abundant
A. niveus LUDLOW シロカタヤブカ common
A. togoi THEOBALD トウゴウヤブカ common

Family Tipulidae

Gen. sp. ガガンボ科の1種 1 *ex*

Family Chironomidae

Chironomus (*Chironomus*) sp. 1 *ex*

Family Dolichopodidae

Psilopus nebulosus Matsumura? マダラアシナガバエ 2 *exs*

Family Syrphidae

Epistrophe balteatus de Geer? ホソヒラタアブ 1 *ex*

Family Drosophilidae

Drosophila (*Sophophora*) *auraria* Peng, type A カオジロショウジョウバエA型 8♂, 2♀
D. (*S.*) *auraria* Peng, type C カオジロショウジョウバエC型 3♂, 2♀
D. (*S.*) *lutea* Kikkawa & Peng キハダショウジョウバエ 20♂, 70♀
D. (*Drosophila*) *immigrans* Sturtevant オオショウジョウバエ 33♂, 95♀
D. (*D.*) *bizonata* Kikkawa & Peng フタオビショウジョウバエ 1♂, 1♀
D. (*D.*) *virilis* Sturtevant クロショウジョウバエ 1♂, 1♀
D. (*D.*) *sordidula* Kikkawa & Peng オオクロショウジョウバエ 1♂
D. (*D.*) *sternopleuralis* Okada 1♂

Family Muscidae

Musca hervei Villeneuve ノイエバエ 1♀
Muscina stabulans (Fallén) オオイエバエ 1♂, 1 *ex*
Ophyra leucostoma (Wiedemann) ヒメクロバエ 1♀

Family Anthomiidae

Gen. sp. ハナバエ科の1種 1♀

Family Calliphoridae

Lucilia ampullacea (Villeneuve) コガネキンバエ 1♂, 3♀
L. sp. 1♀

Family Sarcophagidae

Sarcophaga melanura Meigen シリグロニクバエ 2♀

Phylum VERTEBRATA

Class Reptilia

Order Lacertilia

Family Lacertidae

Takydromus tachydromoides (Schlegel) カナヘビ abundant

Class AVES

Order Columbae

Family Columbidae

Streptopelia orientalis orientalis (LATHAN) キジバト

Order Passera

Family Turdidae

Monticola solitarius magnus (LA TOUCHE) イソヒヨドリ

Family Corvidae

Corvus levaillantii japonensis BONAPARTE ハシブトガラス

REPORT ON THE MOLLUSCA CHIEFLY COLLECTED BY THE S. S. SÔYÔ-MARU OF THE IMPERIAL FISHERIES EXPERIMENTAL STATION ON THE CONTINENTAL SHELF BORDERING JAPAN DURING THE YEARS 1922-1930

PART 3. LAMELLIBRANCHIA (1)[1][2]

TADASHIGE HABE
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With Plates XI–XIII

In this third report, the writer deals with 130 species of the Prionodesmid and Anomalodesmid groups of Lamellibranchiate molluscs. Of these ten species and one subspecies are new to science as follow:

Acila minutoides KURODA et HABE sp. nov.
Neilonella soyoae sp. nov.
Nuculana acinacea sp. nov.
Nuculana yokoyamai arai subsp. nov.
Bentharca rubrotincta KURODA et HABE sp. nov.
Amygdalum soyoae sp. nov.
Ennucula teramachii sp. nov.
Nuculana aikawai sp. nov.
Nuculana soyoae sp. nov.
Saccella soyoae sp. nov.
Striarca soyoae sp. nov.

Before going further, I express my particular thanks to Dr. Tokubei KURODA for his kind suggestions throughout this study.

Class PELECYPODA (LAMELLIBRANCHIA)

Subclass PRIONODESMACEA

Order LIPODONTA

Superfamily Solemyacea

Family Solemyidae

1. *Solemya* (*Acharax*) *japonica* (DUNKER)

(Pl. XII, fig. 1)

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[1] Contributions from the Seto Marine Biological Laboratory, No. 309.

[2] Contributions from the Amakusa Marine Biological Laboratory (Kyushu University), No. 114.

Publ. Seto Mar. Biol. Lab., VI (3), 1958. (Article 15)

1882 *Solemya japonica* DUNKER, Index Moll. Mar. Jap., pp. 220, 261, pl. 14, fig. 3.
1927 *Solemya yamakawai* YOKOYAMA, Jour. Coll. Sci. Imp. Univ. Tokyo, (2) **1**, p. 435, pl. 50, figs. 10, 11.

Localities: St. 76 (off Shimokita Peninsula, 128 m); St. 483 (off Yamaguchi Pref., 130 m); and St. 523 (off Tottori Pref., 181 m).

Distribution: Kyushu, Shikoku and Honshu.

Remarks: This small species is common on the fine sandy bottom in shallow water and differs from *Solemya* (*Petrasma*) *pusilla* GOULD in having the external ligament.

Order PROTOBRANCHIA

Superfamily Nuculacea

Family Nuculidae

2. *Nucula paulula* A. ADAMS

(Pl. XI, figs. 7, 8)

1856 *Nucula paulula* A. ADAMS, Proc. Zool. Soc. London, **24**, p. 52.

Locality: St. 484 (off Yamaguchi Pref., 93 m).

Distribution: Kyushu, Shikoku and Honshu.

Remarks: This small nuculid species is very common on the fine sandy bottom in shallow water.

3. *Nucula* (*Lamellinucula*) *tokyoensis* YOKOYAMA

(Pl. XI, fig. 1)

1920 *Nucula tokyoensis* YOKOYAMA, Jour. Coll. Sci Imp. Univ. Tokyo, **39** (6), p. 181, pl. 19, figs. 10, 11.

Localities and Distribution: Sts. 439 and 452 (off Gotô Islands, 155 m and 154 m) and Sts. 459 and 468 (off Tsushima, 115 m and 112 m).

4. *Nucula* (*Lamellinucula*) *gemmulata* HABE

1953 *Nucula* (*Lamellinucula*) *gemmulata* HABE, Illust. Cat. Jap. Shells, **25**, p. 215.

Localities: Sts. 252 and 255 (Sagami Bay, 289 m and 263 m).

Distribution: Tosa Bay, Shikoku to Sagami Bay, Honshu.

Remarks: This species closely resembles the preceding species in the general features, but may be easily distinguished from the latter in having the more prominent umbo and the smooth escutcheon.

5. *Acila divaricata* (HINDS)

(Pl. XII, fig. 7)

1943 *Nucula divaricata* HINDS, Proc. Zool. Soc. London, 11, p. 97.
1850 *Nucula mirabilis* A. ADAMS et REEVE, Zool. Samarang. Moll., p. 75, pl. 21, fig. 8.
1936 *Acila divaricata vigilia* SCHENCK, Geol. Soc. Amer., Spec. Papers **4**, p. 101, pl. 17, figs. 1–6.

Localities: St. 63 (off Iwate Pref., 331 m); Sts. 479 and 481 (off Tsushima, 148 m and 143 m); Sts. 490, 495, 496 and 499 (off Shimane Pref., 155 m, 146 m, 206 m and 207 m); Sts. 518, 522 and 523 (off Tottori Pref., 229 m, 192 m and 181 m); St. 541 (off Yosa Peninsula, Kyoto Pref., 150 m), St. 613 (off Sado Island, 250 m) and St. 634 (off Akita Pref., 84 m).

Distribution: Japan Sea, China Sea, northern Honshu (South to off Choshi, Chiba Pref.).

Remarks: *A. d. vigilia* is a northern form of this species with various kinds of intermediate form between them.

6. *Acila schencki* KURODA (MS)

1936 *Acila divaricata submirabilis* SCHENCK, Geol. Soc. Amer., Spec. Papers, **4**, p. 88, pl. 11, figs. 9–11; pl. 14, figs. 1, 5, 8–11; pl. 18, figs. 8, 9, 13–15 (non MAKIYAMA).
1954 *Acila schencki* KIRA, Illust. Jap. Shells, pl. 41, fig. 5 (name only).

Localities: St. 248 (Sagami Bay, 170 m) and St. 274 (Senoumi, Suruga Bay, 51 m).

Distribution: Off the Pacific coast of Japan.

7. *Acila* (*Truncacila*) *insignis* GOULD

(Pl. XII, fig. 8)

1861 *Acila insignis* GOULD, Proc. Boston Soc. N. H., **8**, p. 36.

Localities: St. 452 (off Goto Islands, 154 m); Sts. 462, 468, 479 and 481 (off Tsushima, 117 m, 112 m, 148 m and 143 m); St. 483 (off Yamaguchi Pref., 130 m); St. 494 (off Shimane Pref., 110 m); St. 506 (off Oki Islands, 176 m) and St. 523 (off Tottori Pref., 191 m).

Distribution: China Sea, Japan Sea, northern Honshu and Hokkaido.

Remarks: This species is common on the fine sandy bottom in shallow water in the northern Japan.

8. *Acila* (*Truncacila*) *minutoides* KURODA et HABE sp. nov.

Localities: Sts. 252, 255 and 257 (Sagami Bay, 289 m, 263 m and 137 m); St. 259 (Suruga Bay, 118 m) and St. 371 (Enshû-nada, 84 m).

Distribution: Tosa Bay, Shikoku to Sagami Bay, Honshu.

Remarks: This is a small nuculid species the shell of which has the divaricate sculpture as in the preceding species, but the sculpture in this species is more densely set than in that species. The detailed description may be given in another paper in the near future.

Length 5.1 mm, height 4.2 mm, breadth 2.5 mm (type specimen: conjoined valves)

Length 5.0 mm, height 4.1 mm, breadth 2.5 mm (paratype specimen: conjoined valves)

Length 5.7 mm, height 5.0 mm, breadth 1.6 mm (the largest left valve)

Type locality: St. 259 (Suruga Bay).

9. *Ennucula cyrenoides* (KURODA)

(Pl. XI, fig. 2)

1929 *Nucula cyrenoides* KURODA, Venus, **1** (3), App. p. 7, figs, 8, 9.

Localities: St. 11 (off Chôshi, Chiba Pref., 375 m); Sts. 211 and 212 (off Tanabe, Wakayama Pref., 190 m and 181 m); St. 249 (Sagami Bay, 229 m); St. 365 (off Shima Peninsula, 93 m); St. 371 (off Enshu-nada, 84 m); St. 437 (off Gotô Islands, 307 m); Sts. 468 and 473 (off Tsushima, 112 m and 143 m); Sts. 483 and 488 (off Yamaguchi Pref., 130 m and 406 m); Sts. 493 and 494 (off Shimane Pref., 124 m and 110 m); Sts. 503 and 512 (off Oki Islands, 146 m and 141 m); St. 523 (off Tottori Pref., 181 m) and St. 599 (off Sado Island, 181 m).

Distribution: Kyushu, Shikoku and Honshu.

Remarks: This is a solid nuculid species which differs from *E. niponica* (SMITH) in having the strongly oblique chondrophore towards the anterior tooth plate.

10. *Ennucula teramachii* sp. nov.

Locality: St. 392 (Kii Channel between Shikoku and Honshu, 61 m).

Distribution: Tosa Bay, Shikoku and off Wakayama Pref., Honshu.

Shell small, obliquely and triangularly ovate, very inflated, smooth and polished, yellowish green in colour; umbo opisthogyre and prominent; escutcheon distinctly defined, bordering by the keels and lunule also marked by the obtusely angled ridges; chondrophore rather small, projected inwards; tooth plate broad and stout; on the anterior portion are about fifteen and on the shorter posterior about ten teeth; ventral margin smooth; the interior surface shining pearly.

Length 5.0 mm, height 4.2 mm, breadth 2.9 mm (type specimen collected by Mr. Akibumi TERAMACHI)

Length 5.0 mm, height 4.2 mm, breadth 2.8 mm (paratype specimen)

Length 4.5 mm, height 3.5 mm (specimen from St. 392)

Type locality: Tosa Bay, Shikoku.

Remarks: This is the smallest ennuculid species in Japan. This characteristic inflated shell which has a ridge on each side of the umbo, distinguishes this species from the young forms of the other Japanese species.

Family Malletiidae

11. *Malletia (Neilo) carinifera* HABE

1951 *Malletia (Neilo) carinifera* HABE, Gen. Jap. Shells, **1**, p. 22, figs. 16, 17.

Locality: St. 249 (Sagami Bay, 229 m).

Distribution: Tosa Bay to Sagami Bay.

12. *Neilonella coix* HABE

(Pl. XI, fig. 22)

1951 *Neilonella coix* HABE, Gen. Jap. Shells, **1**, p. 23, figs. 12, 13.

Localities: St. 255 (Sagami Bay, 263 m); St. 302 (off Toizaki, Miyazaki Pref., 582 m) and St. 392 (Kii Channel, 61 m).

Distribution: Kyushu to Sagami Bay, Honshu.

13. *Neilonella soyoae* sp. nov.

Locality: St. 414 (off Yaku-shima, south of Kyushu, 514 m).

Remarks: This new species closely resembles the preceding species, but the surface of shell in the former is sculptured with the densely set concentric grooves throughout. Three imperfect valves had been collected from this station. One of them measures 7.2 mm in length by 4.7 mm in height.

14. *Tindaria soyoae* HABE

(Pl. XI, figs. 9, 13)

1953 *Tindaria soyoae* HABE, Jap. Jour. Malac. (Venus), **17**, pp. 130, 136, textfigs. 1, 2.

Locality: St. 304 (off Toizaki, Miyazaki Pref., 241 m).

Remarks: This is a first species of this genus from Japan and only known from the type locality.

Family Nuculanidae

15. *Sarepta speciosa* A. ADAMS

(Pl. XI, figs. 5, 6)

1860 *Sarepta speciosa* A. ADAMS, Ann. Mag. N. H., (3) **5**, p. 303.

Localities: St. 12 (off Chôshi, Chiba Pref., 325 m); Sts. 220, 221 and 341 (Tosa Bay, 234 m, 209 m and 126 m); St. 240 (Sagami Bay, 192 m); St. 259 (Suruga Bay, 188 m); St. 300 (off Toizaki, Miyazaki Pref., 110 m); St. 417 (off Satsuma Peninsula, 192 m); Sts. 432, 433 and 452 (off Gotô Islands, 148 m, 168 m and 154 m); Sts. 459 and 468 (off Tsushima, 115 m and 112 m); St. 483 (off Yamaguchi Pref., 130 m); Sts. 494 and 520 (off Shimane Pref., 110 m and 75 m); Sts. 503 and 504 (off Oki Islands, 146 m and 106 m); St. 546 (Wakasa Bay, 101 m); St, 568 (off Noto Peninsula, 90 m) and St. 625 (off Oga Peninsula, Akita Pref., 51 m).

Distribution: Kyushu, Shikoku and Honshu.

16. *Nuculana pernula* (MÜLLER)

(Pl. XII, figs. 2, 3)

1779 *Nucula pernula* MÜLLER, Beschr. Ges. Naturf, Fr. Berlin, 4, p. 55.

Localities: St. 90 (off Iwate Pref., 152 m); Sts. 475 and 479 (off Tsushima, 192 m and 148 m); St. 506 (off Oki Island, 176 m) and Sts. 595 and 599 (off Sado Island, 145 m and 181 m).

Distribution: Northern Honshu, Japan Sea, Hokkaido, Saghalien and Arctic Sea.

17. *Nuculana* (*Thestyleda*) *aikawai* sp. nov.

(Pl. XI, fig. 3)

Locality: St. 499 (off Iki Islands, 207 m).

Remarks: This species is characteristic in having the very flat shell with well-marked concentric ribs all over the surface. The description is given below.

Shell small, strongly compressed, elongate-ovate, the umbo small, a little elevated; the dorsal slopes, anterior and posterior, nearly straight; anterior dorsal margin shorter than the posterior; anterior side sharply rounded and the posterior end truncated; a slightly curved ridge runs from the umbo to the posterodorsal corner in each valve, forming a smooth, lanceolate escutcheon and another obtuse ridge runs from the umbo to the posteroventral corner; the area between two ridges slightly concave; surface sculptured with lamellate concentric ribs throughtout, hinge teeth bear 9 in anterior part and 15 in the posterior of the small oblique condrophore; a siphonal fold present on the inside of rostration.

Length 9.1 mm, height 5.0 mm, breadth 1.4 mm (type specimen; right valve)

18. *Nuculana* (*Thestyleda*) *scalata* (PRASHAD)

(Pl. XI, figs. 34, 35)

1932 *Nucula* (*Thestlyleda*) *scalata* PRASHAD, Siboga Exped. Lamellibr., p. 22, pl. 1, figs, 30, 31.

Locality: St. 216 (off Kannoura, Kôchi Pref., 274 m).

Distribution: East Indies and this station.

Remarks: This is a first record of this species in Japan.

19. *Nuculana* (*Thestyleda*) *acinacea* sp. nov.

1954 *Nuculana* (*Thestyleda*?) *acinacea* KIRA, Illust. Jap. Shells, pl. 41, fig. 9 (name only).

Localities: Sts. 252 and 255 (Sagami Bay, 289 m and 263 m); 392 (Kii Channel, 61 m) and St. 452 (off Gotô Islands, 154 m).

Remarks: This new species is very close to *Nuculana elaborata* PRASHAD in the general appearance, but the former is not sculptured distinctly all over the shell surface. The following is the description of this new species:

Shell moderate in size, very unequilateral, strongly elongate-ovate, rather inflated, acutely rounded anteriorly and elongated posteriorly; truncated at the posterior end, covered with yellowish green periostracum; the dorsal margin of rostration slightly curved upwardly; the anterior dorsal margin short, a half of the posterior dorsal; two ridges radiate from the umbo posteriorly one to postero-dorsal corner and another to the postero-ventral; surface sculptured with weak growth lines which sometimes grow to the riblets in the anterior area, except the narrow area between two ridges, on which the strong undulations bear; small hinge teeth bear about 18 in anterior series and about 22 in the posterior; a distinct fold on the interior of rostration.

Length 13.8 mm, height 6.5 mm, breadth 4.3 mm (type specimen; conjoined valves, collected by Mr. Akibumi TERAMACHI)

Length 10.8 mm, height 5.3 mm, breadth 3.2 mm (paratype specimen)

Length 10.2 mm, height 4.8 mm, breadth 3.0 mm (paratype specimen)

Type locality: Tosa Bay (Shikoku).

20. *Nuculana* (*Thestyleda*) *soyoae* sp. nov.

Localities: St. 295 (off Tanegashima, 154 m) and St. 392 (Kii Channel, 61 m).

Remarks: This new species differs from all known Japanese nuculanid species in having the smooth area between two ridges radiated from the umbo to the posterior corners.

Shell small, triangularly ovate, rounded anteriorly and truncated posteriorly, tumid and solid, white, covered with yellowish green periostracum; anterior dorsal margin slightly convex and the posterior dorsal gently concave; a ridge runs from the umbo to the postero-dorsal angle, forming a flat escutcheon and another ridge also runs to the postero-ventral angle from the umbo; the area between two ridges concave and smooth; surface sculptured with the coarse concentric grooves, interior white and polished; posterior hinge longer than the anterior; hinge teeth bear sixteen on each side of the triangular chondrophore, a fold on the inside of rostration.

Length 10.6 mm, height 6.1 mm, breadth 4.2 mm (type specimen, conjoined valves)
Type locality: St. 392.

21. *Nuculana* (*Thestyleda*) *yokoyamai* (KURODA)

(Pl. XI, fig. 4; Pl. XII, fig. 5)

1920 *Leda ramsayi* YOKOYAMA, Jour. Coll. Sci. Imp. Univ. Tokyo, **39** (6), p. 176 pl. 19, fig. 3 (non SMITH).
1934 *Nuculana yokoyamai* KURODA, Venus, **4**, p. 204.

Localities: Sts. 11, 12 (off Chôshi, Chiba Pref., 375 m and 325 m); St. 212 (off Tanabe, Wakayama Pref., 181 m); St. 255 (Sagami Bay, 263 m); St. 259 and 276 (Suruga Bay, 188 m and 77 m); St. 304 (off Toizaki, Miyazaki Pref., 241 m); St. 324 (Bungo Channel, 106 m); St. 363 (off Mie Pref., 439 m); St. 371 (Enshû-nada, 84 m); Sts. 451 and 452 (off Gotô Islands, 187 m and 154 m); Sts. 459, 468, 475 and 481 (off Tsushima, 115 m, 112 m, 192 m and 143 m); Sts. 483, 484 and 488 (off Yamaguchi Pref., 130 m, 93 m and 408 m); Sts. 506 and 508 (off Oki Islands, 176 m and 439 m); St. 523 (off Tottori Pref., 181 m); and St. 541 (off Yosa Peninsula, Kyoto Pref.).

Distribution: Kyushu, Shikoku and Honshu.

Remarks: Specimens from Sts. 324, 371, 468 and 484 are separable from the real *N. yokoyamai* in having the decidedly coarser concentric ribs on the surface. Therefore the writer gives a new subspecific term, *arai* (fig. 4) for this form, type specimen of which measures 7.5 m in length, 3.9 m in height and 2.3 m in breadth and has only 15 concentric ribs instead of 20 in the typical form in the specimen of the same length.

22. *Nuculana* (*Robaia*, subgen. nov.) *robai* (KURODA)

1929 *Leda robai* KURODA, Venus, **1**, App. p. 9, textfigs. 6, 7.

Localities: St. 490 (off Yamaguchi Pref., 155 m); St. 577 (off Noto Peninsula, 311 m); St. 609 (off Sado Island, 669 m) and St. 639 (off Aomori Pref., 196 m).

Distribution: Japan Sea.

Remarks: This species differs from other Japanese nuculanid species in having the smooth and polished shell which presents no siphonal ridge on the inside of rostration. Therefore a new subgeneric name, *Robaia*, is proposed for this species. The genus *Yoldia* somewhat resembles this new subgenus in the shell appearance, but the latter has a small, oblique chondrophore, indicating to be a group of the Genus *Nuculana*.

23. *Saccella gordonis* (YOKOYAMA)

1920 *Leda gordonis* YOKOYAMA, Jour. Coll. Sci. Imp. Univ. Tokyo, **39**, p. 177, pl. 19, figs. 4, 5.

Localities: St. 371 (off Enshû-nada, 84 m); St. 432 (off Gotô Islands, 148 m); Sts. 459 and 468 (off Tsushima, 115 m and 112 m); St. 483 (off Yamaguchi Pref., 130 m); and St. 494 (off Shimane Pref., 110 m).

Distribution: Kyushu, Shikoku and Honshu (north to Sagami Bay).

Remarks: This species has weaker growth lines on the surface of shell than the following, which growth lines are decidedly marked on the surface throughout.

24. *Saccella sematensis* (SUZUKI et ISHIZUKA)

1943 *Nuculana confusa sematensis* SUZUKI et ISHIZUKA, Jap. Jour. Malac. (Venus), **13**, pp. 54, 61, pl. 2, figs. 1-10, 12.

Localities: Sts. 211 and 212 (off Tanabe, Wakayama Pref., 190 m and 181 m); St. 221 (off Tosa Bay, 209 m); St. 298 (off Toizaki, Miyazaki Pref., 117 m); St. 314 (off Hyuga-nada, 91 m); St. 371 (Enshû-nada, 84 m); St. 432 (off Gotô Islands, 148 m); St. 470 (Genkai-nada, 73 m); Sts. 483, 484, 488 (off Yamaguchi Pref., 130 m, 93 m, 406 m) and St. 523 (off Tottori Pref., 181 m).

Distribution: Kyushu, Shikoku and Honshu.

Remarks: This species may be easily distinguished from S. *confusa* which lives on the fine sandy bottom in shallow waters in the southern Japan in having the more elongate shell.

25. *Saccella soyoae* sp. nov.

(Pl. XI, fig. 18)

1953 *Costanuculana husamaru* HABE, Gen. Jap. Shells, **4**, p. 281, figs. 732, 740 (non NOMURA).

Locality: St. 249 (Sagami Bay, 229 m).

Remarks: This species was erroneously referred to *Costanuculana husamaru* NOMURA by the close resemblance in shape, but the former has the more flat and solid shell with distantly and regularly undulated grooves than in the latter. Therefore the writer proposes a new name for this interesting species, giving the description in the following lines:

Shell solid, compressed, ovate, rounded anteriorly and pointed posteriorly covered with the greenish periostracum and sculptured with the distantly placed concentric undulation diminished away on the posterior third area; anterior dorsal margin slightly convex and the posterior almost straight; a gently curved obtused keel runs to the posterior end to the umbo, forming the flat dorsal area; lunule very narrow and defined; hinge teeth about 18 on the anterior series and 14 on the posterior, providing a small chondrophore between them; mantle line hardly sinuated at the posterior part; interior porcellaneous.

Length 9.0 mm, height 6.0 mm, breadth 2.0 mm (type specimen: left valve)

Length 10.0 mm, height 7.0 mm, breadth 2.3 mm (paratype specimen: right valve collected from Moeshima in Kagoshima Bay as a Pleistocene fossil).

26. *Saccella kirai* (HABE)

1953 *Neilonella kirai* HABE, Jap. Jour. Malac. (Venas), **17**, p. 137.

Localities: St. 220 (off Tosa Bay, 234 m); St. 304 (off Toizaki, Miyazaki Pref., 241 m); St. 452 (off Gotô Islands, 154 m) and St. 481 (off Tsushima, 143 m).

Remarks: *Saccella sibogai* (PRASHAD) and *S. approximans* (PRASHAD) both from the East Indies closely relate to this species. The first species has the shell more strongly rostrated posteriorly and the second has the more elongate shell than this species proportionally.

27. *Portlandia* (*Portlandella*) *toyamaensis* (KURODA)

1929 *Yoldia toyamaensis* KURODA, Venus, **1**, App. p. 11, textfigs. 14, 15.

Locality: St. 302 (off Toizaki, Miyazaki Pref., 582 m).

Distribution: Toyama Bay and this station.

28. *Portlandia* (*Yoldiella*) *pygmaea* (MÜNSTER)

1837 *Nucula pygmaea* MÜNSTER, Goldfuss Petref. Germ. **2**, p. 157, pl. 125, fig. 17.
1929 *Yoldia* (*Yoldiella*) *kibi* KURODA, Venus, **1**, App. p. 12, textfigs. 20, 21.

Locality: St. 481 (off Tsushima, 143 m).

Distribution: Japan Sea; Okhotsk Sea and Arctic Sea.

Remarks: This is a minute species, measuring only 2.5 mm in length in the fully grown specimen and widely distributes in the northern seas.

29. *Yoldia similis* KURODA et HABE

1929 *Yoldia naganumana* KURODA, Venus, **1**, App. p. 10, textfig. 19 (non YOKOYAMA).
1952 *Yoldia similis* KURODA et HABE, Check List Bibliogr. Recent Mar. Moll. Japan, p. 35.

Localities: St. 151 (off Kinkazan, Miyagi Pref., 123 m); Sts. 479 and 481 (off Tsushima, 148 m and 143 m); St. 495 (off Shimane Pref., 146 m); St. 595 (off Sado Island, 145 m); St. 522 (off Akita Pref., 218 m).

Distribution: Kyushu, Shikoku and Honshu.

Remarks: This species was referred to a fossil species *Y. naganumana* by the close resemblance in shape, but stands near *Cnesterium johanni* rather than that species in having the distinct concentric grooves and some weak oblique striae on the surface.

30. *Cnesterium johanni* (DALL)

(Pl. XII, fig. 4)

1925 *Yoldia johanni* DALL, Proc. U. S. Nat. Mus., **66** (17), p. 32, pl. 29, fig. 7.

Locality: St. 475 (off Tsushima, 192 m).
Distribution: Japan Sea, Okhotsk Sea and northern Japan (south to Kinkazan).

31. *Cnesterium notabile* (YOKOYAMA)

1922 *Yoldia notabilis* YOKOYAMA, Jour. Coll. Sci. Imp. Univ. Tokyo, **44** (1), p. 196, pl. 17, fig. 10.

Locality: St. 438 (off Yamaguchi Pref., 130 m).
Distribution: Japan Sea, Okhotsk Sea and northern Honshu (south to Bôsô Peninsula).

Order TAXODONTA

Superfamily Arcacea

Family Arcidae

32. *Arca miyatensis* OYAMA

(Pl. XII, fig. 6)

1920 *Arca kobeltiana* YOKOYAMA, Jour. Coll. Sci. Imp. Univ. Tokyo, **39**, p. 163, pl. 17, fig. 4 (non PILSBRY).
1951 *Arca miyatensis* OYAMA, Minerarology and Geology, **4**, p. 155.

Localities: St. 78 (off Shiriyazaki, Aomori Pref., 143 m); Sts. 468, 479 and 481 (off Tsushima, 112 m, 148 m and 143 m); St. 483 (off Yamaguchi Pref., 130 m); St. 494 and 498 (off Shimane Pref., 110 m and 139 m) and St. 580 (Toyama Bay, 135 m).
Distribution: Japan Sea and Hokkaido.

33. *Barbatia* (*Ustularca*) *stearnsi* (PILSBRY)

1895 *Arca stearnsi* PILSBRY, Cat. Mar. Moll. Japan, p. 148, pl. 3, figs. 8-10.

Localities: St. 4 (off Bôsô Peninsula, 287 m); St. 330 (off Ashizurizaki, 102 m); and St. 365 (off Ago Bay, Mie Pref., 93 m).
Distribution: Formosa to Honshu (north to Iwate Pref. and Toyama Bay).

34. *Acar congenita* (SMITH)

1885 *Arca congenita* SMITH, Rep. Challenger, Lamellibr., p. 264, pl. 17, figs. 6, 6a.

Remarks: St. 240 (Sagami Bay, 192 m); St. 259 (Suruga Bay, 188 m); Sts. 279

and 376 (Enshû-nada, 155 m and 64 m); St. 301 (off Toizaki, Miyazaki Pref., 181 m); St. 327 (off Uwajima, Ehime Pref., 216 m); Sts. 365 and 376 (off Mie Pref., 93 m and 64 m); St. 481 (off Tsushima, 143 m).

Distaibution: Philippines; Kyushu, Shikoku and Honshu (north to Sagami Bay).

Remarks: This species closely allies to *Acar plicata* which is very common on rocks in shallow waters in general features. But in the former the shell is compressed and has a keel from the umbo to the postero-ventral corner forming a sharp angle and the truncated posterior margin.

35. *Bentharca xenophoricola* (KURODA)

(Pl. XI, fig. 19)

1930 *Bathyarca xenophoricola* KURODA, Venus, **2**, App. p. 33, textfigs. 38, 39.

Localities: Sts. 210, 211, 212 and 352 (off Wakayama Pref., 165 m, 190 m, 181 m and 154 m); Sts. 220 and 222 (Tosa Bay, 234 m and 210 m); Sts. 259, 276, 286 and 288 (Suruga Bay, 188 m, 77 m, 123 m, 77 m); St. 295 (off Tanegashima, 154 m); Sts. 300, 301 and 304 (off Toizaki, Miyazaki Pref., 110 m, 181 m and 240 m); St. 327 (off Uwajima, Ehime Pref., 216 m); St. 330 (off Ashizurizaki, 102 m); Sts. 412 and 417 (off Satsuma Peninsula, 219 m and 192 m); St. 414 (off Yakushima, 514 m); St. 429 (off Amakusa, 223 m); Sts. 444, 451 and 452 (off Gotô Islands, 194 m, 187 m and 154 m); Sts. 468 and 481 (off Tsushima, 112 m and 143 m) and St. 483 (off Yamaguchi Pref., 130 m).

Distribution: Kyushu, Shikoku and Honshu (north to Suruga Bay).

36. *Bentharca rubrotincta* KURODA et HABE sp. nov.

Locality: St. 322 (Bungo Channel between Kyushu and Shikoku, 110 m).

Remarks: This new species may be easily distinguished from the preceding species in having the more flat shell with well developed sculpture and coloured in reddish brown and also with the more numerous small teeth on the hinge plate.

Shell small, rather thin, oblique, triangular in shape, hardly contracted at the anterior third, inequivalved, the smaller right valves is embraced by the left as in other species of this genus, compressed, reddish brown in colour except several narrow white radial bands; dorsal margin straight, forming the wing at each end; ligamental area present quite narrowly between the umbones which are slightly elevated beyond the dorsal line at the about anterior fourth; outer surface marked many radial ribs which are crossed by the strong concentric ridges forming nodules on them; ventral margin crenulated within and bears the weak sinuation at the anterior third, indicating the byssal gape; hinge plate broad but narrowed in the middle; the anterior hinge area bears 5 and the posterior 15 in number of teeth which are small and oblique.

Length 8.2 mm, height 5.0 mm, breadth 1.9 mm (type specimen: right valve)
Length 9.5 mm, height 6.0 mm, breadth 2.2 mm (type specimen: left valve)

37. *Samacar pacifica* (NOMURA et ZINBO)

(Pl. XI, ffgs. 14, 15)

1934 *Pseudogrammatodon pacifica* NOMURA et ZINBO, Sci, Rep. Tohoku Imp. Univ. (2) **16** (2), pl. 53, pl. 5, figs. 6a, b and 7a, b.

Localities: St. 221 (off Tosa Bay, 209 m); St. 240 (Sagami Bay, 192 m); St. 259 and 288 (Suruga Bay, 188 m and 77 m); Sts. 326 and 327 (off Uwajima, Ehime Pref., 393 m and 216 m); St. 384 (the entrance of Ise Bay, 21–38 m); St. 431 (off Amakusa, 152 m); St. 445 (off Gotô Islands, 73 mm); St. 568 (off Noto Peninsula, 90 m); and St. 646 (off Tsugaru Peninsula, 123 m).

Distribution: Kyushu, Shikoku and Honshu.

38. *Pseudogrammatodon dalli* (SMITH)

(Pl. XII, fig. 13)

1885 *Arca* (*Macrodon*) *dalli* SMITH, Rep. Challenger, Lamellibr., p. 269, pl. 17, figs. 10–10b.
1920 *Parallelodon obliquatus* YOKOYAMA, Jour. Coll. Sci. Imp. Uni. Tokyo, **39** (6), p. 170, pl. 18, figs. 9–11.

Localities: Sts. 240 and 255 (Sagami Bay, 192 m and 263 m); Sts. 440, 441, 442, 466, 468, 469, and 474 (off Gotô Islands, 152 m, 373 m, 340 m, 110 m, 112 m, 91 m and 219 m); St. 498 (off Shimane Pref., 139 m); St. 512 (off Oki Islands, 141 m); Sts. 572 and 575 (off Noto Peninsula, 132 and 123 m); St. 627 (off Oga Peninsula, Akita Pref., 148 m); St. 646 (off Tsugaru Peninsula, 123 m); and St. 658 (off Shimokita Peninsula, Aomori Pref., 113 m).

Distribution: China Sea; Japan Sea and Honshu (south to Sagami Bay and Inland sea of Japon).

39. *Bathyarca kyurokusimana* NOMURA et HATAI

(Pl. XI, figs. 23, 24)

1940 *Bathyarca* (*Microcucullaea*) *kyurokusimana* NOMURA et HATAI, Saitô Hô-on Kai Res. Bull., **19**, p. 75, pl. 4, figs. 1a, b.

Localities: Sts. 11 and 12 (off Chôshi, Chiba Pref., 375 and 325 m); St. 205 (off Kumano-nada, 224 m); St. 220 (Tosa Bay, 234 m); St. 255 (Sagami Bay, 263 m); Sts. 259, 276 and 286 (Suruga Bay, 188 m, 77 m and 123 m); St. 295 (off Tanegashima, 154 m); St. 304 (off Toizaki, Miyazaki Pref., 241 m); St. 331 (off Ashizurizaki, 344 m); St. 363 (off Mie Pref., 439 m); St. 392 (Kii Channel, 61 m); St. 417

(off Satsuma Peninsula, 192 m) ; Sts. 447 and 452 (off Gotô Islands, 90 m and 154 m) ; Sts. 468, 469 and 481 (off Tsushima, 112 m, 91 m and 143 m) ; Sts. 483, 484, 486 and 488 (off Yamaguchi Pref., 130 m, 93 m, 139 m and 409 m) ; Sts. 491, 492, 495, 497, and 498 (off Shimane Pref., 112 m, 132 m, 146 m, 143 m and 139 m) ; Sts. 503 and 504 (off Oki Islands, 146 m and 106 m) and St. 580 (Toyama Bay, 135 m).

Distribution: Kyushu, Shikoku and Honshu.

40. *Hawaiarca uwaensis* (YOKOYAMA)

(Pl. XI, fig. 10)

1928 *Arca uwaensis* YOKOYAMA, Jour. Fac. Sci. Imp. Univ. Tokyo, (2) **2** (7), p. 349, pl. 67, figs. 13, 14.

Localities: Sts. 11 and 12 (off Chôshi, Chiba Pref., 375 m and 325 m) ; St. 211 (off Wakayama Pref., 190 m) ; St. 222 (Tosa Bay, 210 m) ; Sts. 240 and 251 (Sagami Bay, 192 m and 165 m) ; Sts. 259 and 276 (Suruga Bay, 188 m and 77 m) ; Sts. 293, 294 and 295 (off Tanegashima, 203 m, 102 m and 154 m) ; St. 300 (off Toizaki, Miyazaki Pref., 110 m) ; St. 322 (Bungo Channel, 110 m) ; St. 327 (Uwajima, Ehime Pref., 216 m) ; Sts. 363, 365 and 376 (off Mie Pref., 439 m, 93 m and 64 m) ; St. 384 (the entrance of Ise Bay, 21–38 m) ; St. 414 (off Yakushima, south of Kyushu, 514 m) ; Sts. 432, 440, 452 (off Gotô Islands, 148 m, 152 m and 154 m) ; Sts. 459, 462 and 468 (off Tsushima, 115 m, 117 m and 112 m) ; St. 470 (Genkai-nada, 73 m) ; Sts. 471, 481, 483, 484 and 488 (off Yamaguchi Pref., 90 m, 143 m, 130 m, 93 m and 406 m) ; Sts. 494, 498, 520 and 521 (off Shimane Pref., 110 m, 139 m, 75 m and 86 m).

Distribution: Kyushu, Shikoku and Honshu (north to Kashima-nada and Oki Islands).

Remarks: *Bentharca xenophoricola* (KURODA), *Bathyarca kyurokusimana* NOMURA et HATAI and *Hawaiarca uwaensis* (YOKOYAMA) are very common arcid species on the continental shelf bordering Japan, especially in the southern region.

41. *Anadara* (*Diluvarca*) *tricenicosta* (NYST)

1848 *Arca tricenicosta* NYST, Mem. Acad. Roy. Belg., **22**, p. 74.
1882 *Scapharca philippiana* DUNKER, Index Moll. Mar. Japon., p. 235.

Localities: St. 300 (off Toizaki, Miyazaki Pref., 110 m) ; St. 365 (off Ago Bay, Mie Pref., 93 m) ; St. 470 (Genkai-nada., 73 m) ; St. 484 and 488 (off Yamaguchi Pref., 93 m and 406 m) ; Sts. 494 and 520 (off Shimane Pref., 110 m and 75 m).

Distribution: East Indies ; China ; Formosa to Honshu (north to Sagami Bay and Shimane Peninsula).

42. *Striarca* (*Galactella*) *symmetrica* (REEVE)

1844 *Arca symmetrica* REEVE, Conch. Icon., Arca, sp. 117.

Locality: St. 294 (off Tanegashima, south of Kyushu, 102 m).

Distribution: East Indies; Philippines; Formosa to Japan (except Hokkaido).

43. *Striarca* (*Spinearca*) *interplicata* (GRABAU et KING)

(Pl. XII, fig. 15)

1920 *Arca symmetrica* YOKOYAMA, Jour. Coll. Sci. Imp. Univ. Tokyo, **39** (6), p. 166, pl. 17, figs. 7, 8 (non REEVE).

1928 *Arca* (*Barbatia*) *interplicata* GRABAU et KING, Shells Peitaiho, p. 161, pl. 1, figs. 9.

1933 *Arca* (*Barbatia*) *yokoyamai* NOMURA, Sci. Rep. Tohoku Imp. Univ., (2) **16** (1), p. 41, pl. 1, figs. 3.

Locality: St. 300 (off Toizaki, Miyazaki Pref., 110 m).

Distribution: Formosa; North China; Japan (north to Sagami Bay and Toyama Bay).

44. *Striarca* (*Spinearca*) *soyoae* sp. nov.

(Pl. XI, figs. 28, 29)

Localities: St. 211 (off Tanabe, Wakayama Pref., 190 m); St. 220 (Tosa Bay, 234 m); St. 240 (Sagami Bay, 192 m); St. 300 (off Toizaki, Miyazaki, Pref., 110 m); St. 345 (off Murotozaki, 165–199 m); St. 417 (off Satsuma Peninsula, 192 m); St. 447 (off Gotô Islands, 90 m); St. 466 (off Iki Island, 110 m); St. 468 (off Tsushima, 112 m); St. 494 (off Shimane Pref., 110 m).

Distribution: Kyushu, Shikoku and Honshu (north to Sagami Bay and off Shimane Pref.).

Remarks: *St.* (*Sp.*) *fausta* HABE, a fossil species from Moeshima in Kagoshima Bay and *St.* (*Sp.*) *alia* (DALL, BARTSCH et REHDER) from Hawaii, closely relate to this new species, but they have less numerous beaded strong radiating ribs on the surface. The description is given in the following lines:

Shell small, ovate, widened backwards, moderately inflated, white, covered with the thin yellowish periostracum; dorsal margin straight, forming the obtuse angle at each end; anterior margin curves roundly and the posterior obliquely and gently curved; the ventral margin nearly straight; umbo elevated slightly beyond the dorsal margin at the anterior third; ligamental area between umbones, narrow but distinct; outer surface marked by many radial riblets, some of which on the postero-ventral area are considerably strong; weak concentric cords cross the radial riblets giving the nodules; interior of the shell white; hinge plate moderately broad, narrowed in the middle; the anterior area bears 13–15 teeth and the posterior 15–18; the anterior, posterior and ventral margins crenulated within.

Type locality: Sagami Bay, Honshu.

Length 8.0 mm, height 5.3 mm, breadth 4.5 mm (type specimen collected by Mr. Ryosuke KAWAMURA)

Length 8.9 mm, height 6.2 mm, breadth 2.5 mm (paratype specimen: right valve from St. 345)

Family Glycymeridae

45. *Glycymeris rotunda* (DUNKER)

1882 *Pectunculus rotundus* DUNKER, Index Moll. Mar. Japon., p. 236, pl, 16, figs. 9, 10.
1922 *Pectunculus yamakawai* YOKOYAMA, Jour. Coll. Sci. Imp. Univ. Tokyo, **40**, p. 190, pl. 16, figs. 4, 5.

Localities: St. 4 (off Bôsô Peninsula, 287 m); Sts. 11, 12 (off Chôshi, Chiba Pref., 375 and 325 m); St. 78 (off Shiriyazaki, Shimokita Peninsula); Sts. 188, 266, 276 and 291 (Suruga Bay, 214 m, 128 m, 77 m and 77 m); St. 193 (Enshû-nada, 265 m); Sts. 211 and 212 (off Wakayama Pref., 190 m and 181 m); Sts. 220, 221, 222, 224 and 340 (Tosa Bay, 234 m, 209 m, 210 m, 251 m and 481 m); St. 236 (off Tateyama, Boso Peninsula, 251 m); Sts 240, 241, 248, 249 and 251 (Sagami Bay, 192 m, 476 m, 170 m, 229 m and 165 m); St. 298 (off Toizaki, Miyazaki Pref., 298 m); Sts. 349 and 392 (Kii Channel, 152 m and 61 m); St. 383 (off Mie Pref., 353 m); St. 429 (off Amakusa, 223 m); Sts. 439, 452, 468, 477 and 481 (off Tsushima, 155, 154, 112 m, 99 m and 143 m); St. 488 (Yamaguchi Pref., 406 m); Sts. 491 and 492 (off Shimane Pref., 112 m and 132 m); St. 506 (off Oki Islands, 176 m); St. 541 (off Yosa Peninsula, Kyoto Pref., 150 m); Sts. 599 and 611 (off Sado Island, 181 m and 143 m); Sts. 627 and 634 (off Akita Pref., 148 m and 84 m).

Distribution: Kyushu, Shikoku and Honshu.

46. *Glycymeris yessoensis* (SOWERBY)

(Pl. XII, fig. 16)

1886 *Pectunculus yessoensis* SOWERBY, Proc. Zool. Soc. London, p. 510, pl. 28, figs. 19.

Locality: St. 81 (off Shimokita Peninsula, 172 m).

Distribution: Northern Honshu, Hokkaido, Saghalien and Korea.

47. *Tucetilla pilsbryi* (YOKOYAMA)

(Pl. XI, fig. 27)

1920 *Pectunculus pilsbryi* YOKOYAMA, Jour, Coll. Sci. Imp. Univ. Tokyo, **39**, p. 170, pl. 18, fig. 8.

Localities: St. 78 (off Shiriyazaki, Shimokita Peninsula, 143 m); Sts. 207 and 210 (off Wakayama Pref., 229 m and 165 m); Sts. 221 and 225 (Tosa Bay, 209 m and 349 m); Sts. 240, 251 and 252 (Sagami Bay, 192 m, 165 m and 286 m); Sts. 259, 274 and 278 (Suruga Bay, 188 m, 51 m and 79 m); Sts. 289, 302 and 304 (off Toizaki, Miyazaki Pref., 117 m, 582 m and 241 m); Sts. 319 and 322 (Bungo Channel, 210 m and

110 m); Sts. 325 and 327 (off Uwajima, Ehime Pref., 210 m and 216 m); St. 345 (off Murotozaki, 165 199 m); St. 376 (Enshu-nada, 64 m); Sts. 431, 437, 439, 440, 441 and 451 (off Gotô Islands, 152 m, 307 m, 155 m, 152 m, 353 m and 187 m); Sts. 461 and 462 (off Tsushima, 120 m and 117 m); St. 466 (Iki Island, 110 m); St. 469 (Genkai-nada, 91 m); St. 521 (off Oki Islands, 86 m); St. 524 (off Tottori Pref., 88 m) and St. 568 (off Noto Peninsula, 90 m).

Distribution: Kyushu, Shikoku and Honshu.

Family Limopsidae

48. *Limopsis tajimae* Sowerby

(Pl. XII, figs. 9, 17)

1914 *Limopsis tajimae* Sowerby, Ann. Mag. N. H., (8) **13**, p. 445, pl. 18, fig. 3.

Localities: St. 116 (off Chôshi, Chiba Pref., 44 m); St. 205 (Kumano-nada, 224 m); Sts. 224 and 340 (Tosa Bay, 251 m and 481 m); St. 236 (off Tateyama, Bôsô Peninsula, 251 m); St. 249 (Sagami Bay, 229 m); Sts. 259, 276 and 277 (Suruga Bay, 188 m, 77 m and 91 m); St. 295 (off Tanegashima, 154 m); St. 321 (Bungo Channel, 457 m); St. 326 (off Uwajima, Ehime Pref., 393 m); St. 343 (off Murotozaki, 366 m); St. 351 (off Tanabe, Wakayama Pref., 384 m); St. 356 (off Shionomisaki, 384 m); Sts. 363 and 381 (off Mie Pref., 439 m and 329 m); St. 392 (Kii Channel, 61 m); Sts. 432, 433, 437 and 441 (off Gotô Islands, 148 m, 168 m, 307 m and 363 m); Sts. 461, 473, 474, 475, 477, 478 and 479 (off Tsushima, 120 m, 143 m, 219 m, 192 m, 99 m, 101 m and 148 m); Sts. 486, 487 and 490 (off Yamaguchi Pref., 139 m, 194 m and 155 m); Sts. 492, 495, 497, 498 and 499 (off Shimane Pref., 132 m, 146 m, 143 m, 139 m and 207 m); Sts. 506 and 512 (off Oki Islands, 176 m and 141 m); Sts. 530 (off Hyogo Pref., 183 m); St. 541 (off Yosa Peninsula, Kyoto Pref., 150 m); Sts. 575 and 577 (off Noto Peninsula, 123 m and 311 m); St. 580 (Toyama Bay, 135 m); St. 591 (off Niigata Pref., 311 m); Sts. 600, 602, 603, 605 and 611 (off Sado Island, 168 m, 205 m, 210 m, 139 m and 143 m); Sts. 616, 619 and 520 (off Yamagata Pref., 106 m, 338 m and 139 m); Sts. 622 and 627 (off Akita Pref., 218 m and 148 m); St. 639 (off Aomori Pref., 196 m); Sts. 644, 645 and 646 (off Tsugaru Peninsula, 150 m, 115 m and 123 m).

Distribution: Kyushu, Shikoku and Honshu.

49. *Limopsis crassula* Habe

(Pl. XII, figs. 10, 11)

1953 *Liomopsis crassula* Habe, Illust. Cat. Jap. Shells, **25**, p. 202, pl. 29, figs. 2, 3.

Localities: St. 600 (off Sado Island, 168 m) and St. 646 (off Tsugaru Peninsula, 123 m).

Distribution: Japan Sea.

50 *Limopsis* (*Emploconia*) *cumingii* A. ADAMS

(Pl. XIII, fig. 3)

1863 *Limopsis cumingii* A. ADAMS, Proc. Zool. Soc. London, p. 229 (1882).
1922 *Limopsis areolata* YOKOYAMA, Jour. Coll. Sci. Imp. Univ. Tokyo, **44**, p. 194, pl. 17, figs. 6, 7.

Localities: St. 278 (Suruga Bay, 79 m); St. 322 (Bungo Channel, 110 m); St. 356 (off Shionomisaki, 384 m); St. 379 (Enshu-nada, 391 m); Sts. 439, 440 and 452 (off Gotô Islands, 155 m, 152 m and 154 m); St. 471 (off Yamaguchi Pref., 90 m); Sts. 476 and 477 (off Tsushima, 84 m and 99 m); and St. 491 (off Shimane Pref., 112 m).

Distribution: Kyushu, Shikoku and Honshu (north to Sagami Bay and off Shimane Pref.).

51. *Pectunculina oblonga* (A. ADAMS)

(Pl. XI, figs. 32, 33)

1860 *Limopsis oblonga* A. ADAMS, Ann. Mag. N. H., (3) **5**, p. 412.
1863 *Limopsis crenata* A. ADAMS, Proc. Zool. Soc. London, p. 230 (1862).
1931 *Limopsis tumidula* THIELE, Deutsche Tiefsee Exped., **21**, p. 186, pl. 1, fig. 26.

Localities: Sts. 11, 12, 13 (Chôshi, Chiba Pref., 375 m, 325 m and 210 m); St. 78 (off Shiriyazaki, Aomori Pref., 143 m); St. 81 (off Shimokita Peninsula, 172 m); St. 90 (off Miyako, Iwate Pref., 152 m); Sts. 193, 371, 376 and 377 (Enshû-nada, 265 m, 84 m, 64 m and 82 m); St. 205 (Kumano-nada, 224 m); St. 207 (off Shionomisaki, 229 m); St. 221 (off Tanabe, Wakayama Pref., 190 m); St. 221 (Tosa Bay, 209 m); Sts. 240, 248, 249, 251 and 252 (Sagami Bay, 192 m, 170 m, 229 m, 165 m and 289 m); Sts. 259, 275, 276, 279, 286 and 288 (Suruga Bay, 188 m, 62 m, 77 m, 155 m, 123 m and 77 m); Sts. 298 and 302 (off Toizaki, Miyazaki Pref., 117 m and 582 m); St. 309 Hyûga-nada, 472 m); St. 322 (Bungo Channel, 110 m); St. 329 (off Uwajima, Ehime Pref., 296 m); St. 347 (off Kannoura, Kochi Pref., 126 m); St. 349 (Kii Channel, 152); St. 352 (off Tanabe, Wakayama Pref., 154 m); St. 357 (off Shionomisaki, 444 m); Sts. 362, 363, 366 and 383 (off Mie Pref., 132 m, 439 m, 494 m and 353 m); St. 384 (the entrance of Ise Bay, 21–38 m); St. 417 (off Satsuma Peninsula, 192 m); Sts. 432, 433, 437, 439, 442, 444, 448 and 452 (off Gotô Islands, 148 m, 168 m, 307 m, 155 m, 340 m, 194 m, 157 m and 154 m); Sts. 468, 469, 475, 477, 479 and 481 (off Tsushima, 112 m, 91 m, 192 m, 99 m, 148 m and 143 m); Sts. 483, 484 and 488 (off Yamaguchi Pref., 130 m, 93 m and 406 m); Sts. 492, 494 and 495 (off Shimane Pref., 132, 110 m, and 146 m); St. 506 (off Oki Islands, 176 m); St. 529 (off Hyogo Pref., 256 m); St. 541 (off Yosa Peninsula, 150 m); St. 577 (off Noto Peninsula, 311 m); St. 599 (off Sado Island, 181 m); Sts. 622 and 637 (off Akita Pref., 218 m and 145 m); and St. 639 (off Aomori Pref., 196 m).

Distribution: Kyushu, Shikoku and Honshu.

Remarks: This species is characteristic by the ventral margin crenulated within and this is one of the commonest species on the continental shelf around Japan together with *Glycymeris rotundata* (DUNKER), and *Limposis tajimae* SOMERBY, *Cryptopecten vesiculosus* (DUNKER) and *Notostrea musashiana* (YOKOYAMA).

52. *Oblimopa japonica* (A. ADAMS)

(Pl. XI, fig. 30)

1863 *Limopsis japonica* A. ADAMS, Proc. Zool. Soc. London, p. 229 (1862).
1953 *Oblimopa soyoae* HABE, Illust. Jap. Jour. Malac. (Venus), **17**, p. 131, figs. 7, 8.

Localities: Sts. 484 and 488 (off Yamaguchi Pref., 93 m and 406 m).

Distributson: Off the coasts of Kyushu and San-in, Honshu.

Remarks: The writer is recently inclined to assume that *Oblimopa soyoae* may be an individual variety of this species after the critical consideration on many materials collected from Amakusa, though he described it as a new species.

53. *Oblimopa forskalli* (A. ADAMS)

1863 *Limopsis forskalii* A. ADAMS, Proc. Zool. Soc. London, p. 230 (1962).
1882 *Limopsis woodwardi* DUNKER, Index. Moll. Mar. Japon, p. 237, pl. 16, figs. 5, 6 (non A. ADAMS).
1930 *Limposis multistriata* KURODA, Venus, **1**, App. p. 17, fig. 26 (non BRUGUIÈRE).

Localities: St. 4 (off Bôsô Peninsula, 287 m); Sts. 211 and 352 (off Wakayama Pref., 190 m and 154 m); St. 270 (Enshu-nada, 91 m); St. 298 (off Toizaki, Miyazaki Pref., 117 m); St. 322 (Bungo Channel, 110 m); St. 340 (Tosa Bay, 481 m); St. 363 (off Mie Pref., 439 m); St. 428 (off Amakusa, 119 m); St. 462 (off Tsushima, 117 m); St. 470 (Genkai-nada, 73 m); Sts. 484 and 488 (off Yamaguchi Pref., 93 m and 406 m); St. 519 (off Tottori Pref., 81 m); St. 520 (off Shimane Pref., 75 m) and St. 528 (off Hyôgo Pref., 326 m).

Distribution: Formosa to Honshu (north to Bôsô Peninsula and off Noto Peninsula).

54. *Aspalima* (*Nipponolimopsis*) *decussata* (A. ADAMS)

(Pl. XI, fig. 11)

1862 *Cyrilla decussata* A. ADAMS, Ann. Mag. N. H., (3), **9**, p. 295.
1922 *Limopsis nipponica* YOKOYAMA, Jour. Coll. Sci. Imp. Univ. Tokyo, **44**, p. 195, pl. 17, figs. 16, 17.
1930 *Limopsis s-kinoshitai* KURODA, Venus, **1**, App. p. 18, figs. 24, 25.
1931 *Limopsis hilgendorfi* THIELE, Deutsche Tiefsee Exped., **21**, p. 184, pl. 1, figs. 21, 21a.

Localities: Sts. 78 and 658 (off Shiriyazaki, Aomori Pref. 143 m and 113 m); St. 207 (off Shionomisaki, 229 m); Sts. 210, 211, 212 and 352 (off Wakayama Pref., 165 m, 190 m, 181 m and 153 m); St. 220 (Tosa Bay, 234 m); St. 240 (Sagami Bay, 192 m); St. 321 (Bungo Channel, 457 m); St. 384 (the entrance of Ise Bay, 21–38 m); St. 441 (off Gotô Islands, 373 m); St. 459 (off Tsushima 115 m); Sts. 595 (off Sado Island, 145 m); and St. 646 (off Tsugaru Peninsula, 113 m).

Distribution: Kyushu, Shikoku and Honshu.

Family Nucinellidae

55. *Nucinella* (*Huxleyia*) *sulcata* (A. ADAMS)

(Pl. XI, figs. 16, 17)

1860 *Huxleyia sulcata* A. ADAMS, Ann. Mag. N. H., (3) **5**, p. 303.

Localities: St. 483 (off Yamaguchi Pref., 130 m); St. 491 (off Shimane Pref., 112 m); and St. 580 (Toyoma Bay, 135 m).

Distribution: Tosa Bay, (Shikoku) and the southern region of Japan Sea.

Remarks: The generic name *Huxleyia* was replaced by *Cyrilla* as a substitute name by A. ADAMS in 1860, but the former does not invalidate by *Huxleya* DYSTER 1858 in Bryozoa, so that this name is in use.

Order DYSODONTA

Superfamily Mytilacea

Family Mytilidae

56. *Crenella yokoyamai* NOMURA

(Pl. XIII, fig. 2)

1922 *Crenella divaricata* YOKOYAMA, Jour. Coll. Sci. Imp. Univ. Tokyo, **44** (1), p. 175, pl. 15, figs. 10, 11.
1932 *Crenella yokoyamai* NOMURA, Sci. Rep. Tohoku, Imp. Univ., (2) **15** (2), p. 74.

Localities: St. 475 (off Tsushima, 192 m) and St. 491 (off Shimane Pref., 112 m).

Distribution: Japan Sea and Hokkaido (Volcano Bay).

57. *Solamen spectabilis* (A. ADAMS)

1862 *Crenella spectabilis* A. ADAMS, Ann. Mag. Nat. Hist., (3) **9**, p. 228.
1907 *Crenella diaphana* DALL, Smiths. Misc. Coll., **50**, p. 171.

Localities: St. 47 (off Kamaishi, Iwate Pref., 355 m); St. 484 (off Yamaguchi Pref., 93 m) and St. 646 (off Tsugaru Peninsula, 123 m).

Distribution: Japan Sea and Honshu (south to Mie Pref.).

58. *Modiolus difficilis* KURODA et HABE

1920 *Modiola modiolus* YOKOYAMA, Jour. Coll. Sci. Imp. Univ. Tokyo, **39** (6), p. 145, pl. 11, fig. 21. (non LINNÈ).
1950 *Volsella difficilis* KURODA et HABE, Illstr. Cat. Jap. Shells, **4**, p. 30.

Localities: Sts. 76 and 78 (off Shimokita Peninsula, Aomori Pref. 128 m and 143 m).

Distribution: Northern Hohshu (south to Tokyo Bay), Hokkaido, Saghalien and Kuriles.

59. *Modiolus margaritaceus* (NOMURA et HATAI)

1940 *Volsella margaritacea* NOMURA et HATAI, Saitô Hô-on Kai Mus. Res. Bull. **19**, p. 77, pl. 4, figs. 2, 3.

Localities: St. 81 (off Shimokita Peninsula, 172 m); St. 259 (Suruga Bay, 188 m); Sts. 301 and 304 (off Toizaki, Miyazaki Pref., 181 m and 241 m); St. 321 (Bungo Channel, 457 m); St. 330 (off Ashizurizaki, 102 m); St. 383 (off Mie Pref., 353 m); St. 431 (off Nagasaki, 152 m); St. 452 (off Gotô Islands, 154 m); Sts. 475, 479 and 481 (off Tsushima, 192 m, 148 m and 143 m); St. 484 and 488 (off Yamaguchi Pref., 93 m and 406 m); Sts. 491, 495, 498 and 521 (off Shimane Pref., 112 m, 146 m, 139 m and 86 m); St. 541 (off Yosa Peninsula, Kyoto Pref., 150 m); Sts. 595 and 599 (off Sado Island, 145 m and 181 m); St. 622 (off Akita Pref., 218 m); St. 646 (off Tsugaru Peninsula, 123 m) and St. 652 (Tsugaru Channel, 110 m).

Distribution: Kyushu, Shikoku and Honshu.

Remarks: A closely allied species, *Modiolus comptus* (SOWERBY) which ranges in Ariake Bay, Seto-naikai (the inland sea of Japan) and Ago Bay, differs from this species in having a distinctly elongate shell.

60. *Modiolus* (*Fulgida*) *flavidus* (DUNKER)

(Pl. XI, fig. 12)

1957 *Volsella flavida* DUNKER, Proc. Zool. Soc. London, (1856), p. 364.

Localities: St. 12 (off Bosô Peninsula, 325 m); St. 376 (Enshû-nada, 64 m); Sts. 484 and 488 (off Yamaguchi Pref., 93 m and 406 m).

Distribution: East Indies; Philippines; Kyushu, Shikoku and Honshu (north to Bôsô Peninsula and Yamaguchi Pref.).

61. *Amygdalum soyoae* sp. nov.

Localities: St. 304 (off Toizaki, Miyazaki Pref., 241 m); and St. 439 (off Gotô Islands, 155 m).

Distribution: Kyushu, Shikoku and Honshu (north to Sagami Bay).

Remarks: Shell thin, fragile, translucent, glossy, elongate-ovate, widened to the posterior end, light yellow in colour, but the antero-ventral area being of a pale yellowish white and in the postero-dorsal translucent area the fulgurations of pale yellowish white bears in the fully grown specimens; anterior margin rounded and produced anteriorly beyond the slightly elevated umbo and the posterior broad and gently curved; surface smooth except the undulate dorsal area, polished and iridescent; hinge line simple, without any teeth; interior also smooth and polished.

Length 11.5 mm., height 6.1 mm., breadth 2.1 mm (type specimen: right valve)

Length 12.0 mm., height 65 mm., breadth 2.2 mm (paratype specimen: right valve)

Length 10.4 mm., height 6.0 mm., breadth 3.4 mm (paratype specimen: conjoined valves from St. 304)

Type locality: St. 439.

This species builts a nest of mud particles and fine byssus threads.

62. *Septifer* (*Mytilisepta*) *virgatus* (WIEGMANN)

1837 *Tichogonia virgata* WIEGMANN, Archiv f. Naturgesch., **3** (**1**), p. 49.

Localities: St. 297 (off Toizaki Pref., 516 m) and St. 327 (off Uwajima, Ehime Pref., 216 m).

Distribution: This intertidal species widely ranges in the Pacific Ocean. The northern limit of distribution of this species is Yoichi, Hokkaido in Japan.

Family Pinnidae

63. *Atrina* (*Servatrina*) *teramachii* HABE

1953 *Atrina* (*Servatrina*) *teramachii* HABE, Illust. Cat. Jap. Shells, **24**, p. 192, pl. 24, fig. 1, pl. 25, fig, 5.

Localities: St. 259 (Suruga Bay, 188 m); St. 354 (off Wakayama Pref., 558 m); St. 440 (off Gotô Islands, 152 m).

Distribution: Kyushu, Shikoku and Honshu (north to Sagami Bay and of Yamaguchi Pref.).

Superfamily Dimyacea

Family Dimyidae

64. *Dimya lima* BARTSCH

(Pl. XI, fig. 21)

1913 *Dimya lima* BARTSCH, Proc. U. S. Nat. Mus., **45**, p. 306, pl. 27, 28, figs. 5, 6.
1951 *Dimya* sp. HABE, Gen. Jap. Shells, **1**, p. 68, fig. 130, 131.

Localities: St. 11 (off Chôshi, Chiba Pref., 375 m); St. 301 (off Toizaki, Miyazaki Pref., 181 m); Sts. 439, 440 and 477 (off Gotô Islands, 155 m and 152 m and 99 m).

Distribution: Philippines, Kyushu, Shikoku and Honshu (north to off Chôshi).

Superfamily Pectinacea

Family Plicatulidae

65. *Plicatula muricata* Sowerby

(Pl. XI, fig. 25)

1873 *Plicatula muricata* Sowerby, Conch. Icon., sp. 9.

Localities: St. 251 (Sagami Bay, 165 m); Sts. 275, 285 and 286 (Suruga Bay, 62 m, 71 m and 123 m); Sts. 294 and 296 (off Tanegashima, 102 m and 219 m); Sts. 298 and 300 (off Toizaki, Miyazaki Pref., 117 m and 110 m); St. 319 (Bungo-nada, 216 m); and St. 332 (off Ashizurizaki, 658 m).

Distribution: East Indies; Ryukyu, Kyushu, Shikoku and Honshu (north to Sagami Bay).

Family Pectinidae

66. *Chlamys lemniscata* (Sowerby)

1853 *Pecten lemniscata* Reeve, Conch. Icon., sp. 170 and index.

Localities: St. 4 (Bôsô Peninsula, 287 m); St. 301 (off Toizaki, Miyazaki Pref. 181 m); St. 327 (off Uwajima Ehime Pref., 216 m); Sts. 440 and 452 (off Gotô Islands, 152 m and 154 m); St. 488 (off Yamaguchi Pref., 406 m) and St. 602 (off Sado Island, 205 m).

Distribution: Kyushu, Shikoku and Honshu (north to Bôsô Peninsula and off Sado).

67. *Chlamys (Swiftopecten) swifti* (Bernardi)

(Pl. XII, fig. 18)

1858 *Pecten swifti* Bernardi, Jour. de Conchyl., **7**, p. 90, pls. 1, 2, fig. 1.

1920 *Pecten tigerrima* Yokoyama, Jour. Coll. Sci. Imp. Univ. Tokyo, **39** (6), p. 155, pl. 15, 14, figs. 5, 6.

Localities: Sts. 76 and 78 (off Shimokita Peninsula 128 m and 143 m).

Distribution: Northern Honshu, Hokkaido, Kuriles and Alaska.

68. *Chlamys (Mimachlamys) jousseaumei* Bavay

1904 *Chlamys jousseaumei* Bavay, Jour. de Conchyl., **52**, p. 203, pl. 6, figs. 9, 10.

Localities: St. 11 (off Chôshi, Chiba Pref., 375 m); St. 90 (off Iwate Pref., 152); Sts. 220, 221 and 222 (Tosa Bay, 234 m, 209 m and 210 m); Sts. 259, 276, 279, 286 and 288 (Suruga Bay, 188 m, 77 m, 155 m, 123 m and 77 m); St. 296 (off Tanegashima, 219 m); St. 309 (Hyûga-nada, 472 m); St. 362 (off Mie Pref. 132 m); St. 379 (Enshû-nada, 391 m); St. 417 (off Satsuma Peninsula, 192 m); St. 429 and 431 (off Amakusa, 223 m and 152 m); Sts. 432, 437, 438, 439, 440, 441, 444, 451, 452 (off Gotô Islands, 148 m, 309 m, 219 m, 155 m, 152 m, 353 m, 194 m, 187 m and 154 m); St. 466 (off Iki Island, 110 m); Sts. 475 and 481 (off Tsushima, 192 m and 143 m); Sts. 483 and 486 (off Yamaguchi Pref., 130 m and 139 m); Sts. 494, 495, 495, 498 and 520 (off Shimane Pref., 110 m, 146 m, 139 m and 75 m); Sts. 503, 504 and 512 (off Oki Islands, 146 m, 106 m, 141 m); St. 546 (Wakasa Bay, 101 m).

Distribution: Kyushu, Shikoku and Honshu.

69. *Chlamys squamata* (GMELIN)

1791 *Ostrea squamata* GMELIN, Syst. Nat., ed. 13, 3329.

Distribution: Formosa to Honshu (north to Bôsô Peninsula and Wakasa Bay).

Localities: St. 300 (off Toizaki, Miyazaki Pref., 110 m); St. 345 (off Murotozaki, 165–199 m); Sts. 471, 484 and 488 (off Yamaguchi Pref, 90 m, 93 m and 406 m) and St. 520 (off Shimane Pref., 75 m).

70. *Cryptopecten vesiculosus* (DUNKER)

1877 *Pecten vesiculosus* DUNKER, Malak. Bl., **24**, p. 72.

Localities; St. 4 (off Bôsô Peninsula, 287 m); Sts. 11 and 12 (off Chôshi, Chiba Pref., 375 m and 325 m); Sts. 188, 266, 274, 275, 276, 277, 278, 279, 285, 286, 288 and 291 (Suruga Bay, 214 m, 128 m, 51 m, 62 m, 77 m, 91 m, 79 m, 115 m, 71 m, 123 m, 77 m and 77 m); St. 205 (Kumano-nada, 224 m); Sts. 210, 211, 212, 350, 352 and 396 (off Wakayama Pref., 165 m, 190 m, 181 m, 611 m, 154 m and 68 m); Sts. 220 and 221 (Tosa Bay, 234 m and 209 m); Sts. 236 and 329 (off Uwajima, Ehime Pref., 251 m and 296 m); Sts. 240, 251 and 255 (Sagami Bay, 192 m, 165 m and 263 m); Sts. 295 and 296 (off Tanegashima, 154 m and 219 m); Sts. 298, 300, 301 and 302 (off Toizaki, Miyazaki Pref., 117 m, 110 m, 181 m and 582 m); St. 309 (Hyûga-nada, 472 m); Sts. 319, 322 and 325 (Bungo Channel, 210, 110 m and 210 m); Sts. 343 and 345 (off Murotozaki, 366 m and 165–199 m); Sts. 362, 365 and 366 (off Mie Pref., 132 m, 93 m and 494 m); Sts. 376, 377, 379 (Enshu-nada, 64 m, 82 m and 391 m); St. 384 (the entrance of Ise Bay, 21–38 m); St. 417 (off Satsuma Peninsula, 192 m); St. 431 (off Amukusa, 152 m); Sts. 432, 433, 437, 438, 439, 440, 442, 444, 445, 447, 448, 449, 451 and 452 (off Gotô Islands, 148 m, 168 m, 307 m, 219 m, 155 m, 152 m, 340 m, 194 m, 73 m, 90 m, 157 m, 155 m 187 m and 154 m); Sts. 457, 459, 461, 462, 466, 468, 469, 470, 576 and 481 (off Tsushima, 112 m, 115 m, 120 m, 117 m, 110 m, 112 m, 91 m, 73 m, 84 m and 143 m); Sts. 483, 484 and 488 (off Yamaguchi Pref., 130 m, 93 m and 406 m); Sts. 491, 492, 494, 499, 520 and 521 (off Shimane Pref., 112 m, 132 m, 110 m, 207 m, 75 m and 86 m); Sts. 503 and 504 (off Oki Islands, 146 m and 106 m); St. 519 (off Tottori Pref., 81 m); St. 546 (Wakasa Bay, 101 m); St. 554 (off Ishikawa Pref., 95 m); Sts. 568 and 575 (off Noto Peninsula, 90 m and 123 m) and St. 646 (off Tsugaru Peninsula, 123 m).

71. *Cryptopecten tissotii* (BERNARDI)

1858 ***Pecten tissoti*** BERNARDI, Jour. de Conchyl., 7, p. 91, pl. 1, fig. 2.

Localities: St. 284 (Suruga Bay, 71 m); St. 201 (off Toizaki, Miyazaki, Pref., 181 m); St. 362 (off Mie Pref., 132 m); Sts. 438, 439 and 440 (off Gotô Islands, 219 m, 155 m and 152 m).

Distribution: Kyushu, Shikoku and Honshu.

72. *Decatopecten striata* (SCHUMACHER)

1817 ***Pallium striatum*** SCHUMACHER, Essai nouv. Syst. Test. pp. 44, 120.
1842 ***Pecten plica*** SOWERBY, Thes, Conch., 1, p. 65, figs. 237-239 (non LINNÈ).

Locality: St. 431 (off Amakusa, 152 m).

Distribution: Formosa to Honshu (north to Bôsô Peninsula and off Noto Peninsula.

73. *Pecten albicans* (SCHROETER)

1802 ***Pecten albicans*** SCHROETER, Archiv f. Zool. 3, p. 135.
1842 ***Pecten laqueatus*** SOWERBY, Thes. Conch., 1, p. 46, pl. 15, fig. 101.

Localities: St. 4 (off Bôsô Peninsula 287 m); St. 11 (off Chôshi, Chiba Pref., 375 m); St. 193, 371, 376 and 377 (Enshû-nada, 265 m, 84 m, 64 m and 82 m); Sts. 211, 212, 352, 395 (off Tanabe, Wakayama Pref., 190 m, 181 m 154 m and 46 m); St. 216 (Kumano-nada, 274 m); Sts. 220 and 222 (Tosa Bay, 234 m and 210 m); Sts. 251 and 255 (Sagami Bay, 165 m and 263 m); St. 286 (Suruga Bay, 123 m); Sts. 296, 298 and 300 (off Toizaki, Miyazaki Pref., 219 m, 117 m and 110 m); St. 309 (Hyûga-nada, 472 m); St. 322 (Bungo Channel, 110 m); St. 368 (off Mie Pref., 600 m); Sts. 439, 447 and 459 (off Gotô Islands, 115 m, 90 m and 115 m); Sts. 462, 464, 468, 476 and 477 (off Tsushima, 117 m, 146 m, 112 m, 84 m and 99 m); Sts. 469 and 470 (Genkai-nada, 91 m and 73 m); Sts. 482, 483, 484, 486 and 488 (off Yamaguchi Pref., 139 m, 130 m, 93 m, 139 m and 409 m); Sts. 492, 493, 494, 520 and 521 (off St. 519 (off Shimane Pref., 132 m, 124 m, 110 m, 75 m and 86 m); St. 503 (off Oki Islands, 146 m); Tottori Pref., 81 m); St. 546 (Wakasa Bay, 101 m); St. 554 (off Ishikawa Pref., 95 m); St. 632 (off Oga Peninsula, Akita Pref., 71 m).

Distribution: Formosa to southern Hokkaido.

74. *Pecten sinensis* SOWERBY

1842 *Pecten sinensis* SOWERBY, Thes. Conch., **1**, p. 48, pl. 16, figs. 120, 111, 134.
1877 *Pecten puncticulatus* DUNKER, Malak. Bl., **24**, p. 71.

Locality: St. 444 (off Gotô Islands, 194 m).

Distribution: China; Formosa to southern Hokkaido.

75. *Patinopecten yessoensis* (JAY)

1857 *Pecten yessoensis* JAY, Rep. Shell Japan Exped, **2**, p. 393, pl. 3, figs. 3, 4 and pl. 4, figs. 1, 2.
1867 *Pecten brandtii* SCHRENCK, Moll. Amurl. Nordjap. Meer., 2, p. 411.

Localities: Sts. 78 and 658 (off Shiriyazaki, Aomori Pref., 143 m and 113 m); St. 577 (off Sado Island, 311 m) and St. 632 (off Akita Pref. 71 m).

Distribution: Northern Honshu, Hokkaido and Kuriles.

76. *Patinopecten tokyoensis* (TOKUNAGA)

1906 *Pecten tokyoensis* TOKUNAGA, Jour. Coll. Sci. Imp. Univ. Tokyo, **21** (2), p. 65, pl. 5, figs. 1-10.

Localities: St. 193 (off Hamamatsu, Enshû-nada, 265 m); Sts. 211 and 353 (off Tanabe, Wakayama Pref., 190 m and 192 m); St. 279 (Suruga Bay, 155 m); and Sts. 432, 439, 440 and 441 (off Gotô Islands, 148 m, 155 m, 152 m and 353 m).

Remarks: This is an extinct species, so that it may be collected from the fossil bed exposed on the sea bottom.

77. *Palliolum* (*Delectopecten*) *macrocheiricola* HABE

1938 *Pseudamusium* (*Palliolum*) *vitreum* HIRO, Annot. Zool. Japon., **17**, p. 474 (non GMELIN).
1951 *Palliolum* (*Delectopecten*) *macrocheiricola* HABE, Gen. Jap. Shells, **1**, p. 80.

Locality: St. 392 (off Kii Channel, 61 m).

Distribution: Tosa Bay, (Shikoku) and Honshu (off Wakayama Pref. to Sagami Bay).

78. *Ctenamusium cmadoritinctum* (KURODA)

1931 *Propeamusium cmadoritinctum* KURODA, Venus, **2**, App. p. 72, fig. 81, 82; 3,: 3, App. p. 77.

Localities: Sts. 220 and 221 (Tosa Bay, 234 m and 209 m); St. 321 (Bungo Channel, 457 m); Sts. 447 and 452 (off Gotô Islands, 90 m and 154 m); St. 475 (off Tsushima, 192 m); and 484 (off Yamaguchi Pref., 93 m).

Distribution: Kyushu (south to Yakushima), Shikoku and Honshu (north to off Bôsô Peninsula).

Remarks: This species is characterized by 9 internal ribs on the shell.

79. *Polynemamussium intuscostatum* (YOKOYAMA)

1920 *Pecten intuscostatus* YOKOYAMA, Jour. Coll. Sci. Imp. Univ. Tokyo, **39**, p. 156, pl. 13, figs. 9, 10.
1922 *Pecten tenuicostulatus* YOKOYAMA, *l. c.*, **44**, p. 184, pl. 17, fig. 15.

Localities: St. 4 (off Bôsô Peninsula, 287 m); Sts. 11 and 12 (off Chôshi, Chiba Pref., 373 m and 325 m); Sts. 211 and 352 (off Tanabe, Wakayama Pref., 190 m and 154 m); Sts. 259 and 279 (Suruga Bay, 188 m and 155 m); St. 295 (off Tanegashima, 154 m); St. 322 (Bungo Channel, 110 m); St. 327 (off Uwajima, Ehime Pref., 216 m); St. 345 (off Murotozaki, 165–199 m); St. 363 (off Mie Pref., 439 m); St. 417 (Satsuma Peninsula, 192 m); Sts. 438, 488 and 452 (off Gotô Islands, 219 m, 157 m and 154 m); Sts. 468 and 475 (off Tsushima, 112 and 192 m); St. 488 (off Yamaguchi Pref., 406 m); St. 646 (off Tsugaru Peninsula, 123 m).

Distribution: Kyushu, Shikoku and Honshu.

Remarks: This species has 16–20 internal ribs on the shell, but the following species has more than 30 when present and the shell attains larger size.

80. *Polynemamussium alaskense* (DALL)

1872 *Pecten alaskensis* DALL, Amer. Jour. Conch., **7**, p. 155, pl. 16, figs. 4.
1931 *Propeamussium simanense* KURODA, Venus, **3**, App. p. 81, figs. 92, 93.

Localities: St. 47 (off Iwate Pref., 355 m); St. 479 (off Tsushima, 148 m); St. 513 (Oki Islands, 284 m); St. 523 (off Tottori Pref., 181 m) and St. 602 (off Sado Island).

Distribution: Northern Honshu, Japan Sea, Hokkaido and Alaska.

81. *Bathyamussium jeffreysii* (SMITH)

(Pl. XI, fig. 20)

1885 *Amussium jeffreysii* SMITH, Challenger Rep. Lamellibr., p. 310, pl. 23, figs. 2, 2a–c.

Localities: St. 392 (Kii Channel) and St. 414 (off Yakushima, 514 m).

Distribution: Indian Ocean, Philippines, Kyushu, Shikoku and Honshu.

82. *Flavamussium caducum* (SMITH)

(Pl. XI, fig. 26)

1885 *Amussium caducum* SMITH, Challenger Rep. Lamellibr., p. 309, pl. 23, figs. 1. 1a. c.
1932 *Propeamussium nakazawai* KURODA, Venus, **3**, App. p. 87, figs. 101, 102.

Locality: St. 412 (off Satsuma Peninsula, 219 m).

Distribution: Philippines, Kyushu, Shikoku and Honshu (north to Suruga Bay).

Family Spondylidae

83. *Spondylus anachanthus* MAWE

1823 *Spondylus anacanthus* MAWE, Linn. Syst. Conch., pl. 2, figs. 3.
1847 *Spondylus nudus* SOWERBY, Thes. Conch., **1**, p. 430, pl. 48, figs. 39, 40.

Localities: St. 218 (off Murotozaki, 132 m); St. 270 (Enshû-nada, 91 m); St. 327 (off Uwajima, Ehime Pref., 216 m).

Distribution: Ryukyu, Kyushu, Shikoku and Honshu (north to Suruga Bay).

Family Limidae

84. *Limatula subauriculata* (MONTAGU)

(Pl. XI, fig. 31)

1808 *Pecten subauriculatus* MONTAGU, Test. Brit. Suppl., p. **63**, pl. 29, figs. 2.

Localities: St. 33 (off Kinkazan, Miyagi Pref., 331 m); St. 255 (Sagami Bay, 263 m); St. 304 (off Toizaki, Miyazaki Pref., 241 m); St. 345 (off Murotozaki, 165–199 m) St. 646 (off Tsugaru Peninsula, 123 m) and 658 (off Shiriyazaki, Aomori Pref., 113 m).

Distribution: Kyushu to Honshu, Saghalien, the North Pacific; the North Atlantic and Arctic Sea.

85. *Limatula kurodai* OYAMA

1943 *Limatula kurodai* OYAMA, Conch. Asiatica, **1**, p. 21, pl. 1, figs. 18a, b; pl. 14, fig. 1.

Localities: St. 4 (off Bôsô Peninsula, 287 m) and St. 294 (off Tanegashima, 102 m).

Distribution: Kyushu and Honshu.

86. *Limatula* (*Stabilima*) *japonica* A. ADAMS

(Pl. XIII, fig. 8)

1863 *Limatula japonica* A. ADAMS, Proc. Zool. Soc. London, p. 509.

Localities: Sts. 211 and 212 (off Tanabe, Wakayama Pref., 190 m and 181 m); St. 220 (Tosa Bay, 234 m); St. 240 (Sagami Bay, 192 m); Sts. 259 and 279 (Suruga Bay, 188 m and 155 m); St. 295 (off Tanegashima, 154 m); St. 321 (Bungo Channel, 457 m); Sts. 352 and 354 (off Wakayama, Pref., 154 m and 558 m); St. 384 (the entrance of Ise Bay, 21–38 m); Sts. 466, 468 and 469 (off Tsushima, 110 m, 112 m and 91 m); St. 521 (off Oki Islands, 86 m); St. 549 (off Fukui Pref., 115 m); Sts. 646 and 647 (off Tsugaru Peninsula, 123 m and 86 m); and St. 658 (off Shiriyazaki, Aomori Pref., 113 m).

Distribution: Kyushu, Shikoku and Honshu.

87. *Notolimea tosana* OYAMA

1943 *Limatula* (*Notolimea*) *tosana* OYAMA, Conch. Asiatica, **1**, p. 11, pl. 1, figs. 1a, b.

Locality: St. 220 (Tosa Bay, 234 m).

Distribution: Tosa Bay, Shikoku.

88. *Lima zushiensis* YOKOYAMA

1920 *Lima zushiensis* YOKOYAMA, Jour. Coll. Sci. Imp. Univ. Tokyo, **39** (6), p. 148, pl. 12, fig. 8.

Localities: St. 269 (off Izu Peninsula, 247 m); 376 (Enshû-nada, 64 m) and St. 455 (off Gotô Islands, 73 m).

Distribution: Kyushu, Shikoku and Honshu (north to off Ibaraki Pref., and Toyama Bay).

Remarks; This species is characterized by the shell coloured in brownish.

89. *Lima fujitai* OYAMA

1929 *Lima quantoensis* FUJITA, Venus **1**, p. 60, pl. 3, fig. 1. (non YOKOYAMA).
1943 *Lima fujitai* OYAMA, Conch. Asiatica. **1**, p. 61, pl. 12, fig. 7.

Localities: Sts. 11 and 12 (off Bôsô Peninsula, 375 m and 325 m); St. 333 (off Ashizurizaki, 179 m); St. 428 and 431 (off Amakusa, 119 m and 152 m); Sts. 439, 440, 441, 445 and 447 (off Gotô Islands, 155 m, 152 m, 353 m, 73 m and 90 m); Sts. 458, 459, 462, 468 and 481 (off Tsushima, 81 m, 115 m, 117 m, 112 m and 143 m); Sts. 503 and 512 (off Oki Islands, 146 m and 141 m) and St. 575 (off Noto Peninsula, 123 m).

Distribution: Kyushu, Shikoku and Honshu (north to Miyagi Pref. and off Noto Peninsula).

90. *Lima tomlini* PRASHAD

1932 *Lima tomlini* PRASHAD, Siboga Exped., Lamellibr., p. 123, pl. 3, figs. 29-31.

Localities: St. 4 (off Bôsô Peninsula, 287 m) and St. 259 (Suruga Bay, 188 m).

Distribution: Arafura Sea, East Indies, Philippines and Japan (north to Bôsô Peninsula).

91. *Lima quantoensis* YOKOYAMA

1920 *Lima quantoensis* YOKOYAMA, Jour. Coll. Sci. Imp. Univ. Tokyo, **39** (6), p. 148, pl. 12, fig. 8.

Locality: St. 205 (Tosa Bay, 224 m).

Remarks: This is a first record of this species in living. This species has 33–36 radial ribs on the elongate shell, while the preceding species has 35–46 radial ones on the circular shell.

92. *Acesta goliath* (SOWERBY)

1883 *Lima goliath* SOWERBY, Proc. Zool. Soc. London, p. 30, pl. 7, fig. 3.

Localities: St. 541 (off Yosa Peninsula, Kyoto Pref., 150 m); St. 575 (off Noto Peninsula, 123 m); St. 605 (off Sado Island, 139 m); St. 619 (off Yamagata Pref., 338 m); Sts. 630 and 637 (off Akita Pref., 150 m and 145 m); St. 640 (off Aomori Pref., 179 m); St. 646 (off Tsugaru Peninsula, 123 m) and St. 658 (off Shiriyazaki, Aomori Pref. 113 m).

Distribution: Japan Sea and Honshu (south to Sagami Bay).

93. *Acesta smithi* (SOWERBY)

1888 *Lima smithi* SOWERBY, Proc. Zool. Soc. London, p. 207, pl. 11, fig. 12.

Localities: Sts. 608, 609 and 610 (off Sado Island, 150 m, 669 m and 145 m); and Sts. 636 and 637 (off Akita Pref., 115 m and 145 m).

Distribution: Honshu (south to Suruga Bay and Wakasa Bay).

94. *Ctenoides lischkei* (LAMY)

1877 *Lima japonica* DUNKER, Mal. Bl., **24**, p. 70 (non SOWERBY).
1885 *Lima dunkeri* SMITH, Challenger Rep. Lamellibr., p. 291, (non HAGENOW).
1930 *Lima lischkei* LAMY., Jour. de Conchyl., **74**, p. 196.

Localities: St. 327 (off Uwajima, Ehime Pref., 216 m); St. 376 (Enshû-nada, 64 m) and St. 455 (off Gotô Islands, 73 m).

Distribution: Formosa, Kyushu, Shikoku and Honshu.

95. *Promantellum orientalis* (A. ADAMS et REEVE)

1850 *Lima orientalis* A. ADAMS et REEVE, Zool. Samarang, Moll., p. 75, pl. 21, fig. 7.

Localities: St. 4 (off Chôshi, Chiba Pref., 375 m); and St. 255 (Sagami Bay, 263 m).

Distribution: Philippines to Japan (north to southern Hokkaido).

Superfamily Anomiacea

Family Anomiidae

96. *Monia umbonata* (GOULD)

(Pl. XII, figs. 12, 19)

1861 *Placunanomia umbonata* GOULD, Proc. Boston Soc. N. H., **8**, p. 39
1861 *Anomia radulina* A. ADAMS, Ann. Mag. N. H., (3) **8**, p. 142.
1861 *Anomia pustulata* A. ADAMS, *l. c.*, p. 142.
1914 *Placunanomia radiata* SOWERBY, Ann. Mag. N. H., (8) **14**, p. 38, pl. 2, fig. 15.
1922 *Anomia sematensis* YOKOYAMA, Jour. Coll. Sci. Imp. Univ. Tokyo, **44**, p. 177, pl. 14, figs. 30, 31.
1922 *Anomia lunulata* YOKOYAMA, *l.c.*, p. 177, pl. 14, figs. 22, 23.

Localities: St. 12 (off Chôshi, Chiba Pref., 325 m); St. 301 (off Toizaki, Miyazaki Pref., 181 m); St. 321 (Bungo Channel, 457 m); St. 349 (Kii Channel, 152 m); St. 362 (Sugura Bay, 132 m); Sts. 447 and 452 (off Gotô Islands, 90 m and 154 m); St. 475 (off Tsushima, 192 m); St. 521 (off Oki Islands, 96 m) and St. 605 (off Sado Island, 139 m).

Distribution: Kyushu, Shikoku and Honshu.

97. *Monia macrochisma* (DESHAYES)

(Pl. XII, fig. 20)

1839 *Anomia macrochisma* DESHAYES, Rev. Zool. Soc. Cuv., p. 359.
1925 *Placunanomia denticostulata* YOKOYAMA, Jour. Fac. Sci. Imp. Univ. Tokyo, (2) **1** (1), p. 16, pl. 2, fig. 3.
1925 *Placunanomia ingens* YOKOYAMA, *l. c.*, p. 16, pl. 4, fig. 1.

Localities: St. 59 (off Iwate Pref., 168 m) and St. 74 (off Shimokita Peninsula, 219 m).

Distribution: Northern Honshu, Hokkaido to the North Pacific.

Superfamily Ostreacea

Family Ostreidae

98. *Notostrea musashiana* (YOKOYAMA)

(Pl. XII, fig. 14)

1920 *Ostrea musashiana* YOKOYAMA, Jour. Coll. Sci. Imp. Univ. Tokyo., **39**, p. 163, pl. 16, figs. 1–3.

Localities: St. 11 (off Chôshi, Chiba Pref., 375 m); Sts. 210, 211, 354 and 395 (off Wakayama Pref., 165 m, 190 m, 558 m and 46 m); Sts. 222 and 342 (off Tosa Bay, 210 m and 288–527 m); Sts. 240, 248, 249 and 251 (Sagami Bay, 191 m, 170 m, 229 m and 165 m); Sts. 259, 266, 274, 275, 276, 278, 279, 286 and 288 (Suruga Bay, 188 m, 128 m, 51 m, 62 m, 77 m, 79 m, 155 m, 123 m and 77 m); Sts. 293, 296 and 298 (off Tanegashima, 203 m, 219 m and 117 m); Sts. 300, 301 and 309 (off Toizaki, Miyazaki

Pref., 110 m, 181 m and 472 m); Sts. 321 and 327 (Bungo Channel, 457 m and 216 m); St. 330 (off Ashizuruzaki, 102 m); St. 345 (off Murotozaki, 165–199 m); St. 347 (Kumano-nada, 126 m); Sts. 362 and 365 (off Mie Pref., 132 m and 93 m); Sts. 371 and 377 (Enshu-nada, 84 m and 82 m); St. 384 (the entrance of Ise Bay, 21–38 m); Sts. 416 and 417 (off Satsuma Peninsula, 378 m and 192 m); St. 425 (off Koshiki Islands, 300 m); Sts. 429 and 431 (off Amakusa, 223 m and 152 m); Sts. 432, 437, 438, 439, 440, 442, 445, 447, 448 and 452 (off Gotô Islands, 148 m, 307 m, 219 m, 155 m, 152 m, 340 m, 73 m, 90 m, 157 m and 154 m); Sts. 468 and 481 (off Tsushima, 112 and 143 m); Sts. 483 and 488 (off Yamaguchi Pref., 130 m and 406 m); Sts. 491, 492 and 520 (off Shimane Pref., 112 m, 132 m and 75 m); Sts. 503 and 512 (off Oki Islands, 146 m and 141 m); Sts. 522 and 523 (off Tottori Pref., 192 m and 181 m); St. 546 (Wakasa Bay, 101 m); St. 554 (off Ishikawa Pref., 95 m); Sts. 572 and 575 (off Noto Peninsula, 132 m and 123 m); St. 591 (off Niigata Pref., 311 m); St. 605 (off Sado Islands, 139 m); Sts. 619 and 620 (off Yamagata Pref., 338 m and 139 m); Sts. 627 and 637 (off Akita Pref., 148 m and 145 m) and St. 646 (off Tsugaru Peninsula, 123 m).

Subclass ANOMALODESMA

Order ANOMALOBRANCHIA

Superfamily Pandoracea

Family Lyonsiidae

99. *Allogramma* (*Bentholyonsia*) *teramachii* HABE

(Pl. XIII, fig. 25)

1952 *Allogramma* (*Bentholyonsia*) *teramachii* HABE, Gen. Jap. Shells, **3**, p. 257, figs. 691, 694–5.
1952 *Allogramma* (*Bentholyonsia*) *teramachii* HABE, Illust. Cat. Jap. Shells, **21**, p. 154, pl. 22, figs. 12–15.

Locality: St. 439 (off Gotô Islands, Kyushu, 155 m).

Distribution: Tosa Bay, Shikoku and off Gotô Islands, Kyushu.

Family Pandoridae

100. *Pandora* (*Kennerlia*) *wardiana* A. ADAMS

(Pl. XIII, fig. 22)

1859 *Pandora wardiana* A. ADAMS, Proc. Zool. Soc. London, p. 487.
1940 *Pandora* (*Kennerleyia*) *japonensis* NOMURA et HATAI (in part), Saitô Hô-on Kai Mus. Res. Bull. **19**, p. 86, pl. 4, figs. 13a–d only.

Localities: St. 493 (off Shimane Pref., 124 m.) and St. 503 (off Oki Islands in Japan Sea, 146 m).

Distribution: Japan Sea and Volcano Bay, Hokkaido.

101. *Pandora* (*Kennerlia*) *pseudobilirata* NOMURA et HATAI

(Pl. XIII, fig. 23)

1874 *Pandora delicatula* SOWERBY, Conch. Icon., sp.17 (non CARPENTER 1864).

1940 *Pandora* (*Kennerleyia*) *pseudolirata* NOMURA et HATAI, Saitô Hô-on Kai Mus. Res. Bull. **19**, p. 87, pl. 4, figs. 14a, b.

1940 *Pandora* (*Kennerleyia*) *japonensis* NOMURA et HATAI, *l. c.*, pl. 4, figs. 14a, b.

Localities: St. 220 (Tosa Bay, Shikoku, 234 m); St. 259 (Suruga Bay, 188 m); St. 286 (Seno-umi, Suruga Bay, 123 m); St. 309 (Hyûga-Nada, 472 m); St. 322 (Bungo Channel, 110 m); St. 452 (off Quelpart Island, 154 m); St. 468 (off Tsushima, 112 m); St. 488 (off Yamaguchi Pref., 406 m); St. 503 (off Oki Islands, 146 m); St. 599 (off Sado Islands, 181 m); St. 946 (off Tsugaru Peninsula, 123 m); St. 658 (off Shimokita Peninsula, 113 m).

Distribution: Kyushu, Shikoku and Honshu.

102. *Pandora* (*Kennerlia*) *otukai* HABE

(Pl. XIII, fig. 18)

1952 *Pandora* (*Kennerlia*) *otukai* HABE, Illust. Cat. Jap. Shells, **18**, p. 124, pl. 18, figs. 11, 12.

Locality: St. 4 (off Bôsô Peninsula, 287 m).

Distribution: Kyushu, Shikoku and the Pacific coast of Honshu.

Remarks: This species was erroneously referred to *P. bicarinata* from California or *P. radiata* from Colombia by various Japanese authors.

103. *Pandora* (*Kennerlia*) *nipponica* HABE

(Pl. XIII, fig. 14)

1952 *Pandora* (*Kennerlia*) *nipponica* HABE, Illust. Cat. Shells, **18**, p. 125, pl. 18, fig. 6.

Localities: St. 392 (Kii Channel, 61 m) and St. 432 (off Gotô Islands, 148 m).

Distribution: Shikoku and Kyushu.

104. *Heteroclidus pulchellus* (YOKOYAMA)

(Pl. XIII, fig. 26)

1926 *Pandora pulchella* YOKOYAMA, Jour. Fac. Sci. Imp. Univ. Tokyo, (2) **1** (9), p. 387, pl. 45, fig. 4.

Localities: St. 523 (off Tottori Pref., 181 m) and St. 572 (off Noto Peninsula, 132 m).

Distribution: Japan Sea.

Family Myochamidae

105. *Myadora fluctuosa* GOULD

(Pl. XIII, fig. 5)

1861 *Myadora fluctuosa* GOULD, Proc. Boston Soc. N. H., 8, p. 23.
1880 *Myadora proxima* SMITH, Proc. Zool. Soc. London, p. 586, pl. 53, figs. 8, 8a, b.
1882 *Myadora triangularis* DUNKER, Index Moll. Mar. Jap., p. 181, pl. 7, figs. 11, 12.

Localities: St. 459 (off Tsushima, 115 m); St. 470 (off Fukuoka Pref., 73 m); Sts. 484 and 488 (off Yamaguchi Pref., 93 m and 406 m); Sts. 494 and 499 (off Shimane Pref., 110 m and 207 m).

Distribution: Kyushu, Shikoku and Honshu.

106. *Myadora japonica* HABE

(Pl. XIII, fig. 10)

1950 *Myadora japonica* HABE, Illust. Cat. Jap. Shells, 4, p. 27, pl. 4, figs. 4–6.

Localities: Sts. 11 and 12 (off Chôshi, Chiba Pref., 375 m and 325 m); St. 78 (off Shimokita Peninsula, 143 m); Sts. 240 and 251 (Sagami Bay, 192 m and 165 m); Sts. 321 and 324 (Bungo Channel, 457 m and 106 m); St. 365 (off Shima Peninsula, 93 m); St. 371 (Enshû-nada, 84 m); St. 439 (off Gotô Islands, 165 m); Sts. 462, 469, 475, 477 and 481 (off Tsushima, 117 m, 91 m, 192 m, 99 m and 143 m); St. 483 (off Yamaguchi Pref., 130 m); Sts. 492 and 498 (off Shimane Pref., 132 m and 139 m); St. 504 (off Oki Islands, 106 m); St. 523 (off Tottori Pref., 181 m); St. 451 (off Yosa Peninsula, 150 m).

Distribution: Kyushu, Shikoku and Honshu.

107. *Myadora yokoyamai* HABE

(Pl. XIII, fig. 15)

1950 *Myadora yokoyamai* HABE, Illust. Cat. Jap. Shells, 4, p. 28, pl. 4, figs. 7–9.

Locality: St. 432 (off Gotô Islands, Kyushû, 142 m).

Remarks: This species has never been collected in living state until today. Therefore though many detached valves of this species were collected from this station it is very doubtful whether they are of Recent shells or of fossil ones.

108. *Myadora soyoae* HABE

(Pl. XIII, fig. 16)

1950 *Myadora soyoae* HABE, Illust. Cat. Jap. Shells, 4, p. 25, pl. 4, fig. 18.

Localities: St. 325 (Bungo Channel, 210 m) and St. 462 (off Tsushima, 117 m).

Distribution: This species was collected from only two stations cited above until today.

109. *Myadora reeveana* SMITH

(Pl. XIII, fig. 28)

1880 *Myadora reeveana* SMITH, Proc. Zool. Soc. London, p. 586, pl. 53, figs. 10, 10a

Locality: St. 4 (off Bôsô Peninsula, 287 m).
Distribution: Kyushu, Shikoku and Honsnu.

110. *Myadora teramachii* HABE

(Pl. XIII, fig. 11)

1950 *Myadora teramachii* HABE, Illust. Cat. Jap. Shells, **4**, p. 28, pl. 4, figs. 14–16.

Locality: St. 392 (Kii Channel, 62 m).
Distribution: Tosa Bay, Shikoku and Kii Channel between Shikoku and Honshu.

Family Pholadomyidae

111. *Pholadomya pacifica* DALL

(Pl. XIII, fig. 7)

1907 *Pholadomya pacifica* DALL, Smiths. Misc. Coll.. **50** (2), p. 172.
1925 *Pholadomya pacifica* DALL, Proc. U. S. Nat. Mus., **66** (17), p. 24, pl. 29, figs. 8, 9.
1940 *Pholadomya japonica* NOMURA et NIINO, Rec. Oceanogr. Works Japan, **12** (1), p. 61.

Localities: St. 384 (the entrance of Ise Bay, 38 m) and St. 503 (off Oki Islands, 146 m).
Distribution: Shikoku and Honshu.

Family Thraciidae

112. *Parvithracia sematana* (YOKOYAMA)

1922 *Thracia sematana* YOKOYAMA, Jour. Coll. Sci. Imp. Univ. Tokyo, **44** (1), p. 173, pl. 14, figs. 17, 18.

Localities: St. 259 (Suruga Bay, 188 m) and St. 371 (Enshû-nada, 84 m).
Distribution: The Pacific coast of Honshu.

113. *Thraciopsis transmontana* (YOKOYAMA)

(Pl. XIII, fig. 13)

1922 *Thracia transmontana* YOKOYAMA, Jour. Coll. Sci. Imp. Univ. Tokyo, **44** (1), p. 172, pl. 14, figs. 13–14.

Localities: St. 4 (off Bôsô Peninsula, 287 m); St. 481 (off Tsushima, 143 m) and St. 503 (off Oki Islands, 146 m).

Distribution: Kyushu, Shikoku and Honshu.

Superfamily Clavagellacea

Family Clavagellidae

114. *Clavagella* (*Stirpulina*) *ramosa* DUNKER

(Pl. XIII, fig. 21)

1882 *Clavagella ramosa* DUNKER, Index Moll. Mar. Jap., p. 172, pl. 16, figs. 1, 2.

Locality: St. 455 (off Quelpart Island between Kyushu and Korea, 90 m).

Distribution: Kyushu, Shikoku and Honshu.

Order SEPTIBRANCHIA

Superfamily Poromyacea

Family Verticordidae

115. *Verticordia* (*Spinosipella*) *japonica* A, ADAMS

(Pl. XIII, fig. 1)

1862 *Verticordia japonica* A. ADAMS, Ann. Mag. N. H., (3) **9**, p. 224.
1952 *Verticordia* (*Spinosipella*) *japonica* KURODA, Jap. Jour. Conch. (Venus), **17** (1), p. 10, pl. 1, figs. 10, 11.

Locality: St. 276 (Senoumi in Suruga Bay, 77 m).

Distribution: Kyushu, Shikoku and Honohu; East Indies.

Remarks: *Verticordia deshayesiana* FISCHER (1862) from the Chinese seas may be a local form of this species.

116. *Verticordia* (*Haliris*) *multicostata* A. ADAMS

(Pl. XIII, fig. 4)

1862 *Verticordia multicostata* A. ADAMS, Ann. Mag. N. H., (3) **9**, p. 224.
1952 *Verticordia* (*Haliris*) *multicostata* KURODA, Jap. Jour. Malac. (Venus), **17** (1), p. 9, pl. 1, figs. 4, 5.

Locality: St. 259 (Suruga Bay, 188 m).

Distribution: Kyushu, Shikoku and Honshu.

117. *Euciroa cistagemma* KURODA

(Pl. XIII, fig. 9)

1951 *Euciroa cistagemma* KURODA, Jap. Jour. Malac. (Venus), 17(1), p. 14, pl. 1, figs. 16–18.

Locality: St. 437 (off Gotô Islands, Kyushu, 307 m).

Family Poromyidae

118. *Poromya flexuosa* YOKOYAMA

(Pl. XIII, fig. 27)

1922 *Poromya flexuosa* YOKOYAMA, Jour. Coll. Sci. Imp. Univ. Tokyo, 44 (1), p. 173, pl. 14, figs. 15, 16.

Localities: St. 4 (off Bôsô Peninsula, 287 m); St. 12 (off Chôshi, Chiba Pref., 325 m); St. 221 (Tosa Bay, 209 m); St. 259 (Suruga Bay, 188 m); St. 352 (Kii Channel, 154 m); St. 371 (Enshû-nada, 84 m); St. 384 (the entrance of Ise Bay, 21–38 m); Sts. 432, 439, 440, 444, 451 and 452 (off Gotô Islands, 148 m, 155 m, 152 m, 194 m, 187 m and 154 m); St. 470 (off Fukuoka Pref., 73 m); St. 475 (off Tsushima, 192 m); Sts. 471, 484 and 486 (off Yamaguchi Pref., 90 m, 93 m and 139 m); Sts. 493, 494, 495 and 520 (off Shimane Pref., 124 m, 110 m, 146 m and 75 m); Sts. 503 and 504 (off Oki Islands, 146 m and 106 m); St. 523 (off Tottori Pref., 181 m); Sts. 546 and 549 (Wakasa Bay, 101 m and 115 m); St. 580 (Toyama Bay, 135 m); St. 646 (off Tsugaru Peninsula, 123 m).

119. *Poromya castanea* HABE

(Pl. XIII, fig. 24)

1952 *Poromya castanea* HABE, Illust. Cat. Jap. Shells, 21, p. 156, pl. 22, fig. 10.

Locality: St. 499 (off Oki Islands in Japan Sea, 207 m).
Distribution: Japan Sea.

120. *Dermatomya tenuiconcha soyoae* HABE

(Pl. XIII, fig. 6)

1952 *Dermatomya tenuiconcha soyoae* HABE, Illust. Cat. Jap. Shells, 21, p. 158, pl. 22, figs. 7, 8.

Locality: St. 33 (off Kinkazan, Miyagi Pref., 331 m); St. 62 (off Kuji, Iwate Pref., 631 m) and St. 71 (off Hachinoe, Aomori Pref., 444 m).
Distribution: The Pacific coast of northern Honshu.

121. *Cetoconcha japonica* HABE

(Pl. XIII, fig. 12)

1952 *Cetoconcha japonica* HABE, Illust. Cat. Jap. Shells, **21**, p. 159, pl. 22, figs. 2-4.

Locality: St. 32 (off Kinkazan, Miyagi Pref., 611 m).
Distribution: Shikoku and Honshu.

Family Cuspidariidae

122. *Cuspidaria suganumai* NOMURA

1940 *Cuspidaria suganumai* NOMURA, Rec. Oceanogr. Works Japan, **12** (1), p. 101, pl. 2, figs. 13a, b.

Localities: St. 255 (Sagami Bay, 263 m); Sts. 259 and 286 (Suruga Bay, 188 m and 123 m); Sts. 304 and 319 (off Miyazaki Pref., 241 m and 210 m); St. 392 (Kii Channel, 61 m); St. 433 (off Gotô Islands, 168 m).
Distribution: Kyushu, Shikoku and Honshu.

123. *Cuspidaria japonica* KURODA

1948 *Cuspidaria japonica* KURODA, Jap. Jour. Malac. (Venus), **15** (1), p. 14, pl. 1, fig. 2.

Localities: St. 392 (Kii Channel, 61 m) and St. 462 (off Gotô Islands, 154 m).
Distribution; Shikoku and Kyushu.

124. *Cuspidaria nobilis* (A. ADAMS)

(Pl. XIII, fig. 17)

1864 *Neaera nobilis* A. ADAMS, Ann.`Mag. N. H., (3) **15**, p. 207.
1929 *Cuspidaria chinensis* FUJITA, Venus, **1** (2), p. 62, pl. 3, fig. 3. (non GRIFFITH et PIDGEON).

Localities: St. 286 (Suruga Bay, 123 m) and St. 439 (off Gotô Islands, 155 m).
Distribution: Kyushu, Shikoku and Honshu.

125. *Cardiomya gouldiana septentrionalis* (KURODA)

1948 *Cuspidaria* (*Cardiomya*) *gouldiana septentrionalis* KURODA, Venus, **15**, pp. 3, 18, pl. 2, fig. 12.

Localities: St. 4 (off Bôsô Peninsula, 287 m); St. 12 (off Chôshi, Chiba Pref., 325 m); St. 371 (Enshû-nada, 84 m); Sts. 484 and 488 (off Yamaguchi Pref., 93 m and 406 m); Sts. 493 and 494 (off Shimane Pref., 124 m and 110 m).

Distribution: Kyushu, Shikoku and Honshu (*C. gouldiana septentrionalis*) and Philippines (*C. gouldiana gouldiana*).

126. *Cardiomya tosaensis* (KURODA)

1948 *Cuspidaria* (*Cardiomya*) *tosaensis* KURODA, Jap. Jour. Malac. (Venus), **15**, p. 18, pl. 2, fig. 13.

Localities: St. 324 (Bungo Channel, 106 m) and St. 432 (off Gotô Islands, 148 m).
Distribution: Kyushu, Shikoku and Honshu.

127 *Cardiomya reticulata* (KURODA)

1948 *Cuspidaria* (*Cardiomya*) *reticulata* KURODA, Jap. Jour. Malac., **15**, p. 19, pl. 2, fig. 17.

Locality: St. 452 (off Gotô Islands, Kyushu, 154 m).
Distribution: Kyushu and Shikoku.

128. *Myonera fluctuosa* KURODA

1948 *Myonera fluctuosa* KURODA, Jap. Jour. Malac. (Venus), **15**, p. 25, pl. 2, fig. 20.

Localities: St. 12 (off Chôshi, Chiba Pref., 325 m); St. 322 (Bungo Channel, 110 m); St. 371 (Enshû-nada, 84 m) and St. 452 (off Gotô Islands, 154 m).
Distribution: Kyushu, Shikoku and Honshu.

129. *Plectodon ligula* (YOKOYAMA)

1922 *Cuspidaria ligula* YOKOYAMA, Jour. Coll. Sci. Imp. Univ. Tokyo, **44** (1), p. 169, pl. 14, figs. 3, 4.

Localities: St. 4 (off Bôsô Peninsula, 287 m) and St. 81 (off Shimokita Peninsula, 172 m).
Distribution: Kyushu, Shikoku and Honshu.

130. *Plectodon* (*Pseudoneaera*) *iridella* KURODA

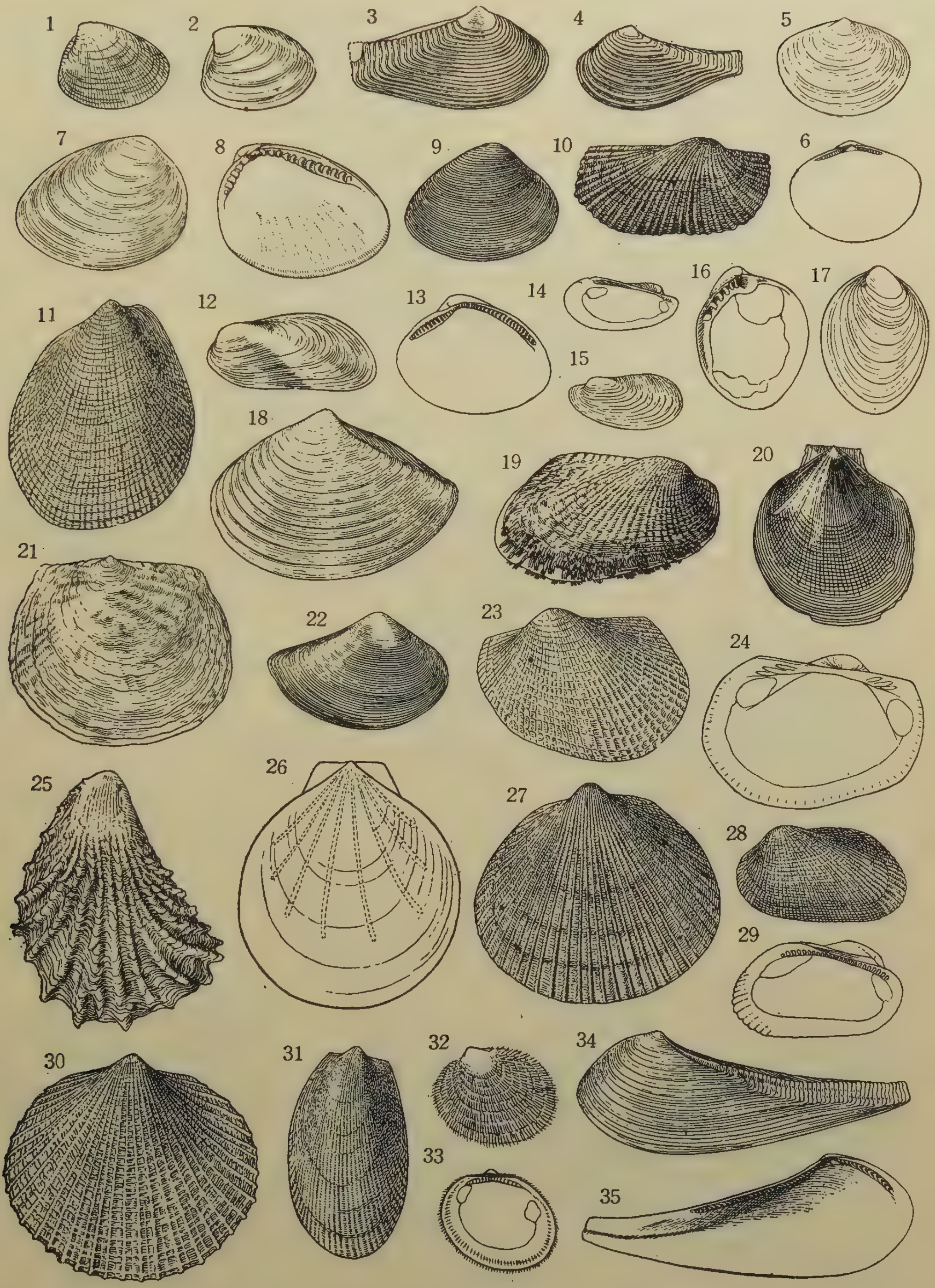
(Pl. XIII, figs. 19, 20)

1948 *Cuspidaria* (*Pseudoneaera*) *iridella* KURODA, Jap. Jour. Malac., **15**, p. 25, pl. 2, fig. 9.

Localities: St. 259 (Suruga Bay, 188 m); St. 300 (off Toizaki, Miyazaki Pref., 110 m); St. 452 (off Gotô Islands, 154 m) and St. 468 (off Tsushima 112 m).
Distribution: Kyushu, Shikoku and Honshu.

EXPLANATION OF PLATE XI

Fig. 1. *Nucula (Lamellinucula) tokyoensis* Yokoyama, 6.5×5.8 mm.
2. *Ennucula cyrenoides* (Kuroda), 12.0×9.2 mm.
3. *Nuculana (Thestyleda) aikawai* sp. nov., 9.1×5.0 mm.
4. *Nuculana (Thestyleda) yokoyamai arai* subsp. nov., 7.5×3.9 mm.
5, 6. *Sarepta speciosa* A. Adams, 13.0×10.0 mm.
7, 8. *Nucula paulula* A. Adams, 3.5×2.7 mm.
9, 13. *Tindaria soyoae* Habe, 4.8×3.8 mm.
10. *Hawaiarca uwaensis* (Yokoyama), 11.2×5.8 mm.
11. *Aspalima (Nipponolimopsis) decussata* (A. Adams), 5.4×6.5 mm.
12. *Modiolus (Fulgida) flavidus* (Dunker), 33.9×15.4 mm.
14, 15. *Samacar pacifica* (Nomura et Zinbo), 22.2×12.4 mm.
16, 17. *Nucinella (Huxleyia) sulcata* (A. Adams), 2.3×2.8 mm.
18. *Saccella soyoae* sp. nov., 9.0×6.0 mm.
19. *Bentharca xenophoricola* (Kuroda), 16.7×10.4 mm.
20. *Bathyamussium jeffreysi* (Smith), 19.7×20.6 mm.
21. *Dimya lima* Bartsch, 7.7×6.7 mm.
22. *Neilonella coix* Habe, 8.2×5.4 mm.
23, 24. *Bathyarca kyurokusimana* Nomura et Hatai, 4.4×3.4 mm.
25. *Plicatula muricata* Sowerby, 20.5×17.3 mm.
26. *Flavamussium caducum* (Smith), 22.9×25.0 mm.
27. *Tucetilla pilsbryi* (Yokoyama), 17.2×15.4 mm.
28, 29. *Striarca (Spinearca) soyoae* sp. nov., 8.0×5.3 mm.
30. *Oblimopa japonica* (A. Adams), 14.2×14.1 mm.
31. *Limatula subauriculata* (Montagu), 6.2×10.9 mm.
32, 33. *Pectunculina oblonga* (A. Adams), 10.4×9.7 mm.
34, 35. *Nuculana (Thestyleda) scalata* Prashad, 11.3×4.7 mm.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T. Habe: Mollusca Chiefly Collected by the Sôyô-maru, 3.

EXPLANATION OF PLATE XII

Fig. 1. *Solemya* (*Acharax*) *japonica* DUNKER, 8.7×3.0×1.8 mm.
2, 3. *Nuculana pernula* (MÜLLER), 13.6×7.3×4.5 mm.
4. *Cnesterium johanni* (DALL), 29.4×15.0×5.6 mm.
5. *Nuculana* (*Thestyleda*) *yokoyamai* (KURODA), 9.2×5.0×3.0 mm.
6. *Arca miyatensis* OYAMA, 38.4×21.9×19.4 mm.
7. *Acila divaricata* (HINDS), 26.0×20.0×15.0 mm.
8. *Acila* (*Truncacila*) *insignis* (GOULD), 13.5×10.0×6.7 mm.
9, 17. *Limopsis tajimae* SOWERBY, 25.9×21.9×11.5 mm.
10, 11. *Limopsis crassula* HABE, 12.6×12.0×3.2 mm (right valve).
12. *Monia umbonata* (GOULD), 23.9×23.5×2.5 mm.
13. *Pseudogrammatodon dalli* (SMITH), 41.7×26.3×17.6 mm.
14. *Notostrea musashiana* (YOKOYAMA), 23.0×33.0×16.0 mm.
15. *Striarca* (*Spinearca*) *interplicata* (GRABAU et KING), 14.3×10.6×5.2mm.
16. *Glycymeris yessoensis* (SOWERBY), 44.3×42.6×21.6 mm.
18. *Chlamys* (*Swiftopecten*) *swifti* (BERNARDI), 56.3×67.2×24.2 mm.
19. *Monia umbonata* (GOULD), 21.1×29.5×2.5 mm.
20. *Monia macrochisma* (DESHAYES) 50.5×50.7×15.0 mm.

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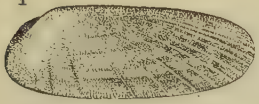

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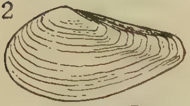

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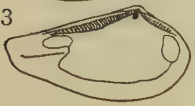

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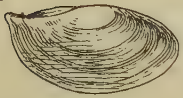

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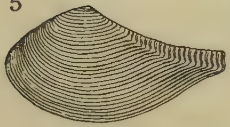

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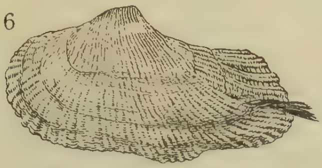

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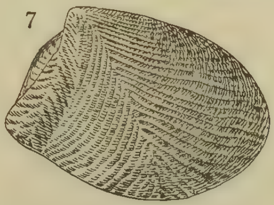

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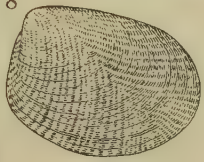

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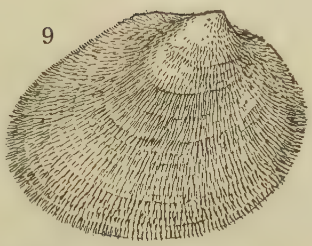

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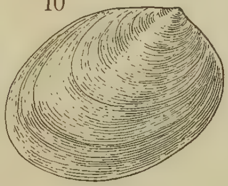

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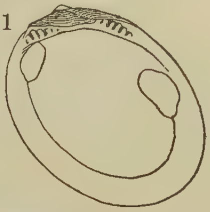

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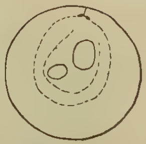

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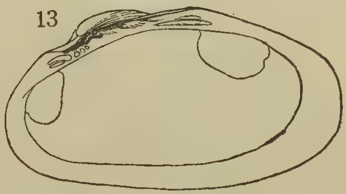

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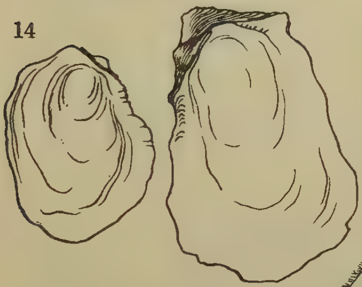

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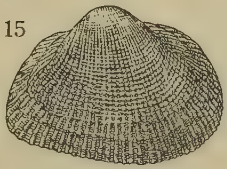

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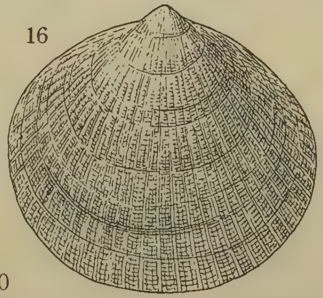

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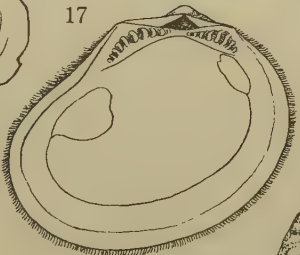

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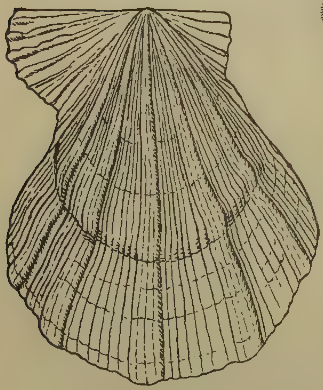

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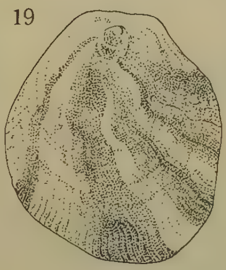

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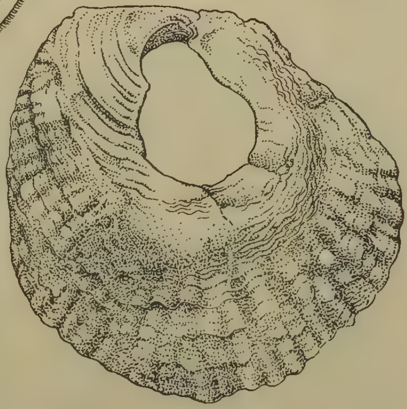
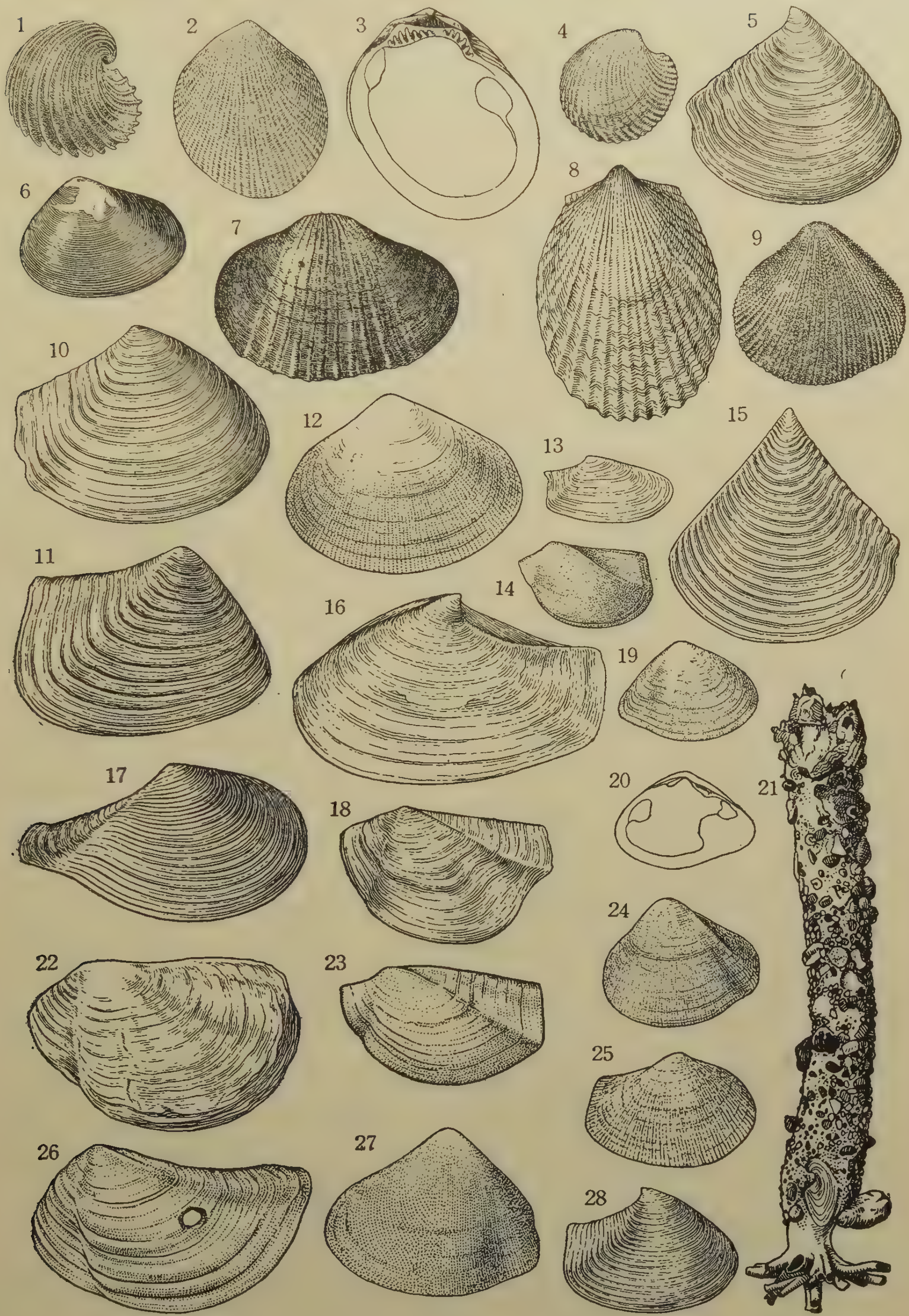


T. Habe: Mollusca Chiefly Collected by the Sôyô-maru, 3.

EXPLANATION OF PLATE XIII

Fig. 1. *Verticordia (Spinosipella) japonica* A. Adams, 12.0×13.7 mm.
2. *Crenella yokoyamai* Nomura, 2.4×2.9 mm.
3. *Limopsis (Empleconia) cumingi* A. Adams, 19.0×15.5 mm.
4. *Verticordia (Haliris) multicostata* A. Adams, 5.7×5.6 mm.
5. *Myadora fluctuosa* Gould, 10.1×8.6 mm.
6. *Dermatomya tenuiconcha soyoae* Habe, 16.1×12.8 mm.
7. *Pholadomya pacifica* Dall, 44.0×30.0 mm.
8. *Limatula (Stabilima) japonica* A. Adams, 17.4×12.6 mm.
9. *Euciroa cistagemma* Kuroda, 17.9×17.6 mm.
10. *Myadora japonica* Habe, 16.1×12.6 mm.
11. *Myadora teramachii* Habe, 12.8×9.7 mm.
12. *Cetoconcha japonica* Habe, 16.2×13.0 mm.
13. *Thraciopsis transmontana* (Yokoyama), 6.9×3.5 mm.
14. *Pandora (Kennerlia) nipponica* Habe, 12.7×9.3 mm.
15. *Myadora yokoyamai* Habe, 10.7×10.0 mm.
16. *Myadora soyoae* Habe, 16.0×10.5 mm.
17. *Cuspidaria nobilis* A. Adams, 39.9×22.2 mm.
18. *Pandora (Kennerlia) otukai* Habe, 19.9×12.8 mm.
19, 20. *Plectodon (Pseudoneaera) iridella* Kuroda, 6.8×5.0 mm.
21. *Clavagella (Stirpulina) ramosa* Dunker, length of tube 75.0 mm.
22. *Pandora (Kennerlia) wardiana* A. Adams, 51.6×32.5 mm.
23. *Pandora (Kennerlia) pseudobilirata* (Nomura et Hatai), 19.8×12.0 mm.
24. *Poromya castanea* Habe, 15.0×12.7 mm.
25. *Allogramma (Bentholyonsia) teramachii* Habe, 22.5×15.8 mm.
26. *Heteroclidus pulchellus* (Yokoyama), 33.8×22.0 mm.
27. *Poromya flexuosa* Yokoyama, 15.6×13.7 mm.
28. *Myadora reeveana* Smith, 5.8×4.3 mm.

PLATE XIII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T. HABE: MOLLUSCA CHIEFLY COLLECTED BY THE SÔYÔ-MARU, 3.

STUDIES ON THE CIRRIPEDIAN FAUNA OF JAPAN

VII. CIRRIPEDS FROM SAGAMI BAY[1]

Huzio UTINOMI

Seto Marine Biological Laboratory, Sirahama

With 10 Text-figures

The present paper forms a part of a series dealing with the regional Cirripedian fauna on the Japanese coasts intermittently published since 1935, and is mainly based on the collection of Cirripedia Thoracica deposited in the Biological Laboratory of the Imperial Household which was recently submitted to me for study.

The material studied contains a few lot collected from other districts, but for the most part is that from the eastern region of Sagami Bay where the most extensive collecting has been done year by year. Localities for each species given in the text are mostly the local names of banks or shoals in that bay, unless otherwise mentioned.

Although the present collection is unexpectedly small, it may be of considerable interest both from a systematic and zoogeographic point of view, since a new remarkable primitive type of the Scalpellidae was found; it was already described in detail under the name *Pisiscalpellum withersi* n. gen. et n. sp. in a separate paper (Utinomi, 1958). The remaining species, comprising 22 species and subspecies in all, have been apparently already described, and all reported already from the Japanese waters, so that further detailed descriptions may be scarcely necessary.

In addition to this collection, eight more species are added which had not been as yet recorded from this district, but I have ever collected there, mainly at Misaki.

Lastly, a list of the Cirripedia Thoracica recorded from Sagami Bay and adjacent areas is given in order to make a faunistic comparison with the other parts of Japanese waters.

Here I wish to thank Dr. Hirotaro Hattori of the Biological Laboratory of the Imperial Household and staff members for placing this interesting collection into my hand for examination.

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1) Contributions from the Seto Marine Biological Laboratory, No. 310.

Publ. Seto Mar. Biol. Lab., VI (3), 1958. (Article 16)

LEPADOMORPHA

Family Scalpellidae

1. *Calantica eos* (PILSBRY)

Scalpellum (*Calantica*) *eos* PILSBRY, 1907, p. 9, fig. 2 (type locality: off Ose-zaki, Suruga Bay in 71 fathoms).
Calantica eos PILSBRY, 1908, p. 106; HIRO, 1937a, p. 26, fig. 18.
Calantica eos longisquama HIRO, 1932a, p. 479, figs. 4a–f and 5d–e; pl. 30, figs. 3–3b.
? *Scalpellum* (*Calantica*) *studeri* WELTNER, 1922, p. 100, pl. 3, figs. 13–13b (part).

Material. Crust. No. 138. 6 adult (12–28 mm long) and 2 juvenile (2.2–7 mm long) specimens attached to a hydrocoral *Stylaster profundiporus* forma *typica* BROCH. Amadaiba, 70 fathoms. 16–VII–1934.

Crust. No. 144. 12 specimens attached to a stone. Off Zyôgasima Is., 50–70 fathoms. 22–VII–1935.

Crust. No. 202. One specimen attached to a hydrocoral *Stylaster profundiporus* forma *typica* BROCH. Amadaiba, 55 fathoms. 7–VIII–1936.

Crust. No. 204. One specimen attached to a hydrocoral *Stylaster dentatus* BROCH. Amadaiba, 50 fathoms. 9–VIII–1936.

Crust. No. 730. One specimen attached to an empty polychaete tube. Kadone, off Nagai, 100 m.

Crust. No. 1315. 3 large (40 mm, 45 mm and 46 mm long respectively) and 1 young (10 mm long) specimens. Aoyama-dasi, Amadaiba, 74–86 m. 17–VII–1957.

Range. Suruga and Sagami Bays only.

Remarks. As described before under the name *Calantica eos longisquama* (HIRO, 1932a), the relative length between the occludent and carinal margins in the capitulum is very variable in the present material too. The cuticle is smooth and yellowish brown. All the plates in the upper whorl are usually tinged with orange hue distally, and the scales in the peduncle are elongate, tiny and half buried in the cuticle. The specimens collected by OWSTON and DÖDERLEIN in Japan, probably from Sagami Bay, which were regarded by WELTNER (1922) as *Calantica studeri* n. sp., may be referable to this species, although it is questionable whether WELTNER's type material from West Australian coast and Three King Islands too is homogeneous or not.

2. *Smilium scorpio* (AURIVILLIUS)

Scalpellum scorpio AURIVILLIUS, 1894, p. 46, pl. 3, figs. 6–8; pl. 9, figs. 10–13 (type localities: China Sea, south of Amoy, in 60 m and Hirado Strait, Japan, in 80 m).
Smilium scorpio+sexcornutum PILSBRY, 1908, p. 107.
Smilium sexcornutum KRÜGER, 1911, p. 15, pl. 1, fig. 2a; pl. 2, figs. 14–17.
Calantica scorpio HIRO, 1932a, p. 481; HIRO, 1933a, p. 13, fig. 1; pl. 1, figs. 1–2 (synonymy); HIRO, 1937a, p. 29, fig. 21.

Material. Crust. No. 201. 2 specimens attached to a bryozoan. Aoyama-dasi, Amadaiba, 55 fathoms. 7–VIII–1936.

Range. Common around the coasts of Japan northward to Kasima-nada on the Pacific coast side and to Toyama Bay on the Japan Sea side. Recorded also from China Sea and Gulf of Siam.

3. *Smilium acutum* (HOEK)

Scalpellum acutum HOEK, 1883, p. 80, pl. 3, fig. 19; pl. 8, fig. 12 (type localities: in the Atlantic near the Azores and in the Pacific near the Kermadec Islands).

Smilium acutum HIRO, 1933a, p. 17, pl. 1, fig. 3 (synonymy); HIRO, 1937a, p. 30, fig. 22.

Material. Crust. No. 201. One specimen (6 mm long and 2 mm wide) attached to a hydroid. Aoyama-dasi, Amadaiba, 55 fathoms. 7–VIII–1936.

Range. Widespread in deep-sea in all oceans.

4. *Pisiscalpellum withersi* UTINOMI

Pisiscalpellum withersi (n. gen. et n. sp.) UTINOMI, 1958, p. 113, figs. 1–3.

Material. Crust. No. 1181. 3 specimens (holotype and paratypes). Mosaki, Kamegi-syô, 5–6 fathoms. 23–VII–1956.

Range. Known only from the single locality mentioned above.

Remarks. This is a remarkably specialized scalpellid, apparently representing an intermediate state between the genera *Calantica* (*Scillaelepas*) and *Scalpellum* (*Arcoscalpellum*). Its detailed description, together with a discussion on the systematic position, were already given in a separate paper mentioned above.

5. *Scalpellum nipponense* PILSBRY

Scalpellum nipponense PILSBRY, 1907a, p. 73, fig. 29 (type locality; off Manazuru-zaki, Sagami Bay, between 120–265 fathoms).

Scalpellum intermedium NILSSON-CANTELL, 1921, p. 208, fig. 33 (not HOEK, 1883).

Scalpellum nipponense BROCH, 1931, p. 24, fig. 9 (synonymy); HIRO, 1933a, p. 25, fig. 5; pl. 1, figs. 7–9b (synonymy); HIRO, 1937a, p. 43, fig. 34.

Material. Crust. No. 207. One specimen. Amadaiba, 300 m. 6–IX–1936.

Range. Pacific coast of Japan, from Kasima-nada to Tôtômi-nada.

6. *Scalpellum vitreum* HOEK

Scalpellum vitreum HOEK, 1883, p. 65 (type locality: 34°37′ Lat. N., 140°32′ Long. E., off Bôsô Peninsula, 1875 fathoms); HIRO, 1937a, p. 40, fig. 31.

Material. Crust. No. 138. One specimen attached to a hydrocoral *Stylaster profundiporus* forma *typica* BROCH, together with *Calantica eos* (PILSBRY). Amadaiba, 70 fathoms. 16–VII–1934.

Crust. No. 1315. 2 specimens attached to *Calantica eos* (PILSBRY). Aoyama-dasi, Amadaiba, 74–86 m. 17–VII–1957.

Crust. No. 1447. One specimen on a gravel. WSW 2 miles of Zyôga-sima, 169–230 m. 19–III–1958.

Description. Capitulum is long-oval, widest in the middle, composed of 14 wholly calcified plates, like the peduncle covered by a very thin and sparsely pilose cuticle. With the exception of carina and rostrum, the plates are sculptured with distinct riblets radiating from the umbones, not crossed by any transverse riblets or stripes.

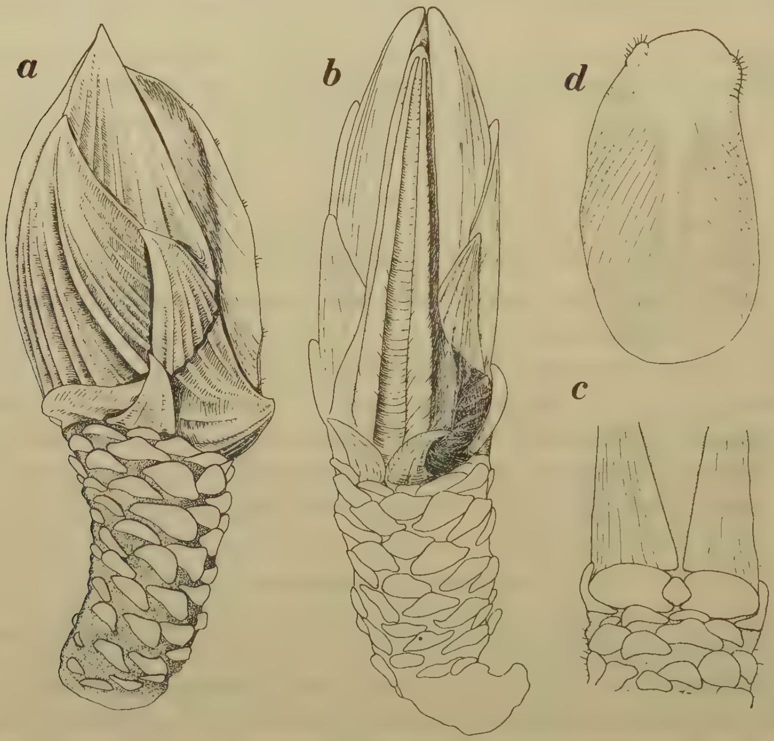

Fig. 1. *Scalpellum vitreum* HOEK.

a, Animal (Crust. No. 138), lateral side. *b*, The same, carinal side.
c, Rostral part. *d*, Complemental male. (*a–c* ×9, *d* ×70)

Scutum trapezoidal, about half as wide as long, with beaked apex. Occludent margin convex; tergal, lateral and basal margins are straight, the basal shortest. There is a curved diagonal riblet from apex to basolateral angle, stronger than the other riblets.

Tergum triangular, with almost perfectly straight margins. Riblets radiating from the pointed apex are rather lower than those of scutum.

Carina evenly curved with apical umbo situated a little below the tip of capitulum.

Dorsally a deep and broad longitudinal furrow runs from the apex to the basis, bounded by high and broad flanges along which about 6 tufts of short hairs are adorned. The sides are narrow below, wider above; basal margin concealed under two carinal latera.

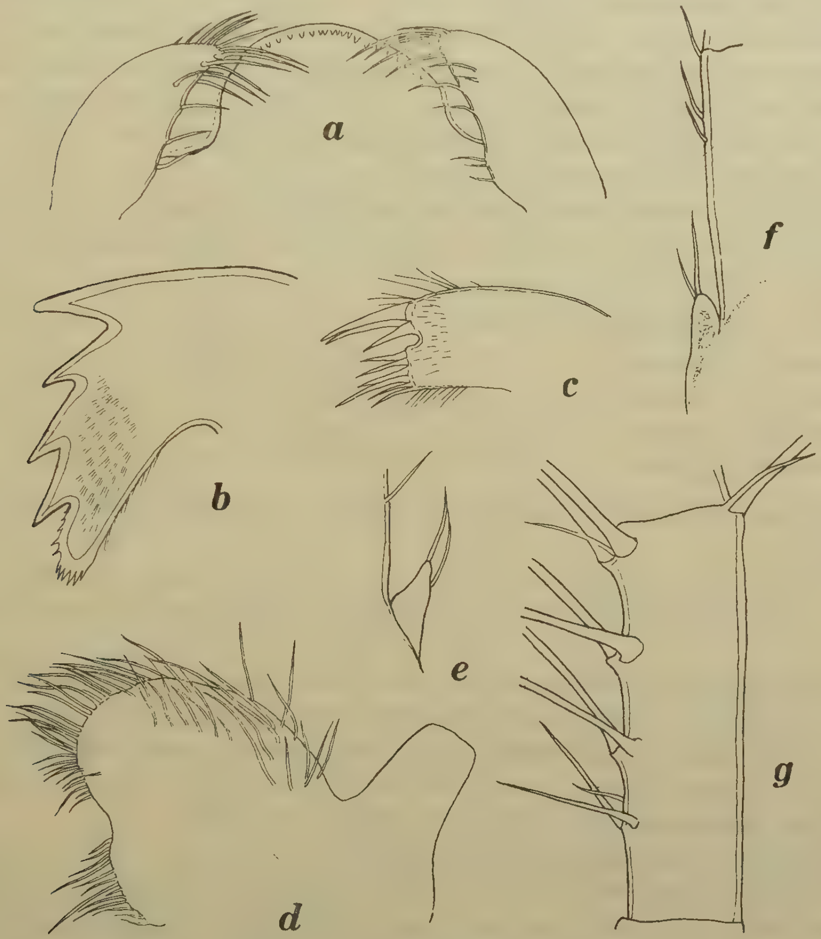

Fig. 2. *Scalpellum vitreum* HOEK.

a, Labrum and palpi. *b*, Mandible. *c*, Maxilla I. *d*, Maxilla II. *e*, *f*, Caudal appendage. *g*, Intermediate segment of cirrus VI. (*a–f* ×95, *g* ×150)

Upper latus triangular∼trapezoidal with distinct riblets radiating from the umbo between the bordering scutal and tergal margins, so that the basocarinal margin may be slightly curved and undulated.

Rostrum very small, roughly quadrangular or lanceolate and wholly exposed, inserting between the rostral latera of both sides.

Rostral latus quadrangular, with the widest scutal margin almost parallel to the basal margin insensively continued from the lateral margin. Its rostral margin is shortest and hollowed out to meet at a rostrum. Umbo is apical, but radiating riblets not so distinct as in other plates.

Inframedian latus small, triangular, with the umbo at the strongly recurved apex. Radiating riblets distinct, 4 in number.

Carinal latus in lateral view is pentagonal, the carinal margin being divided into two parts at the umbo projecting beyond the carina below which the two latera meet. The upper part is slightly concave, the lower convex, and the upper slightly longer than the lower. Riblets running towards the upper margin are more distinct than those towards the lateral and basal margins.

Peduncle is cylindrical, gradually narrower downwards and shorter than capitulum. It is covered with large, transversely lengthened, scales in about 9 transverse rows of about 8 or 9 scales each.

Cat. No. of specimens	1447	138	1315a	1315b
Length of capitulum	8.5 mm	7.0 mm	2.5 mm	2.0 mm
Breadth of capitulum	5.5	4.0	2.5	2.0
Length of peduncle	2.2	4.5	1.5	1.8
Diameter of peduncle	3.2	2.0	1.3	1.3

Cirri show the following numbers of segments in a specimen dissected (Cat. No. 1315a).

I		II		III		IV		V		VI	
6	8	10	12	13	12	12	13	12	13	13	13

All of them are relatively short and slender, with subequal length in both rami, except only the first cirrus having the anterior ramus about 3/4 as long as the posterior. Four pairs of bristles are on the front of each segment.

Caudal appendage minute, one-jointed, conical, with only 2 terminal bristles as long as the appendage itself.

Mouth-parts are ordinary as figured in Fig. 2.

The animal as here described is a female with no trace of a penis.

Complemental male. In a specimen (Cat. No. 138) only one lodged in a pouch situated on the inner side of the scutum near the occludent margin. The form resembles closely that of *Scalpellum velutinum* HOEK and *S. formosum* HOEK (cf. HIRO, 1933a, p. 30, fig. 9) in the transverse arrangement of minute hairs and the presence of two hairy patches near the pole. No trace of valves and no antennae. Muscle-fibres of the sac very distinct, but opening of the sac hardly visible.

Remarks. By the shape of the plates in the capitulum and their remarkable riblets radiating from the umbo, the present specimens may be referable to *Scalpellum vitreum* HOEK which was collected by the "Challenger" from the south of Bôsô Peninsula at the depth of 1875 fathoms. Originally this species was represented by a single specimen, lacking a male.

Family Oxynaspididae

7. *Oxynaspis celata* DARWIN

Oxynaspis celata DARWIN, 1851, p. 134, pl. 3, fig. 1 (type locality: Madeira, eastern Atlantic); WELTNER, 1897, p. 242; NILSSON-CANTELL, 1921, p. 226, fig. 37; BROCH, 1922, p. 275, figs. 32–33 (as forma *japonica*).

Material. Crust. No. 146. 9 specimens attached to *Antipathes* sp. Maruyama-dasi, Amadaiba, 50 fathoms. 3–VIII–1934.

Among them the largest one is measured 12 mm in total length. All the plates are closely fitting and covered with spiny bark; the scutum has an evenly rounded baso-lateral angle, instead of right-angled as in *O. pacifica* HIRO which is more common in Japanese waters.

Range. Widespread in tropical and warm temperate seas, on antipatharians. Earlier recorded from Japanese waters by the authors listed above.

Family Lepadidae

8. *Lepas anatifera* LINNAEUS

Material. Crust. No. 140. A large specimen on a floating bamboo. Akitani, Hayama. 15–I–1929.

Crust. No. 253. Juveniles on a floating timber. Issiki, Hayama. 24–II–1929.

Crust. No. 524. Juveniles on a floating timber. Off Samezima, Hayama. 15–VII–1949.

Crust. No. 1138. 2 specimens attached to a buoy. Off Issiki, Hayama. 14–VII–1956.

Range. Cosmopolitan, pelagic in all seas.

9. *Lepas anserifera* LINNAEUS

Material. Crust. No. 145. 23 specimens on a floating bamboo and 3 on a pumice stone. Akitani, Hayama. 15–I–1929.

Range. Cosmopolitan, pelagic in all seas.

10. *Lepas hilli* (LEACH)

Material. Not contained in the collection of the Biological Laboratory of the Imperial Household.

Only once I collected this species on the beach of Zyôgasima, south of Misaki, in July, 1931. This species is very alike *L. anatifera*, so that it may be sometimes confused with the latter. The material I have collected is now deposited in the collection of the Seto Marine Biological Laboratory.

Range. Cosmopolitan, pelagic in all seas.

11. *Lepas fascicularis* ELLIS et SOLANDER

Material. Not contained in the collection of the Biological Laboratory of the Imperial Household.

But I collected ten specimens attached to a floating kelp at Misaki, in July, 1931, which are also in the collection of the Seto Marine Biological Laboratory. They measured 9 to 47 mm in length and encrusted wholly with *Obelia*-like hydroid colonies.

Range. Cosmopolitan, pelagic in all seas.

12. *Alepas pacifica* PILSBRY

Alepas pacifica PILSBRY, 1907a, p. 105, fig. 36 (type locality: north of San Francisco, California); NILSSON-CANTELL, 1921, p. 243, fig. 42; HIRO, 1937b, p. 404, fig. 7 (synonymy).

Material. Not contained in the collection of the Biological Laboratory of the Imperial Household.

In the collection of the Seto Marine Biological Laboratory, there is a specimen attached to the oral arm of a medusa *Pelagia panopyra* which I obtained at Misaki. The scuta were not found in this specimen (about 20 mm long).

Range. Widespread in tropical and temperate seas, as attached to pelagic medusae.

Family Heteralepadidae

13. *Heteralepas* (*Heteralepas*) *japonica* (AURIVILLUS)

Alepas japonica AURIVILLIUS, 1894, p. 28, pl. 2, figs. 14–15; pl. 8, figs. 3 & 7; pl. 9, fig. 3 (type locality: Hirado Strait, 80 m).

Heteralepas (*Heteralepas*) *japonica* HIRO, 1933a, p. 48, figs. 13–14 (synonymy).

Material. Crust. No. 137. 7 specimens attached to a *Cirrhipathes*-stem. West of Kamegisyô, 45 fathoms. 5–IX–1935.

Crust. No. 203. Numerous specimens crowded on a *Cirrhipathes*-stem. West of Kamegisyô, 40 fathoms. 14–VIII–1936.

Crust. No. 1127. 2 specimens attached to an *Antipathes*-stem, together with *Balanus poecilotheca* KRÜGER, all covered by an orange-colored colony of *Clavularia mikado* UTINOMI. Between Maruyama-dasi and Kannonzuka-dasi, 60–80 m. 13–VII–1956.

Range. Japan and Indo-Malayan seas.

14. *Heteralepas* (*Paralepas*) *globosa* HIRO

Heteralepas (*Paralepas*) *globosa* HIRO, 1936, p. 221, fig. 1 (type locality: Tosa Bay, Kôti Pref., 30–100 fathoms); HIRO, 1937a, p. 74, fig. 62.

Material. Crust. No. 136. 2 specimens attached to a dead shell. 4 miles south of Zyôgasima, 400–500 m. 4–IX–1935.

Description. Two specimens contained in this collection agree fairly with the figure and descriptions of *Heteralepas* (*Paralepas*) *globosa* earlier described from Tosa Bay. The specimens are larger than those given earlier by me, as shown in the following measurements.

Length of capitulum	21.5 mm	16.0 mm
Breadth of capitulum	17.0	14.0
Thickness of capitulum	14.0	11.0
Length of peduncle	11.2	11.0
Diameter of peduncle	8–9	7.5
Length of orifice	4.5	3.2

Capitulum oval in lateral view, about 3/4 as wide as long, not much compressed laterally and broadly rounded dorsally without carinal crest. Integument very thick and hard, with smooth surface. Orifice relatively small, not protuberant, with puckered lips, its length about 1/5 of the length of capitulum itself. A triangular patch indicating the position of the scutum is found on each side below the orifice.

Peduncle markedly differentiated from capitulum by constrictions, shorter and narrower than capitulum.

The color is, according to a label appended, "Bittersweet pink in life, but in alcohol maple color."

The internal parts agree with those earlier described. The numbers of segments in the cirri and the caudal appendage are:

I	II	III	IV	V	VI	C.A.
12 8	18 16	7+ 17	21 19	19 17	18 18	12

Range. Tosa Bay, 30–100 fathoms (on the gastropod shell *Guildfordia triumphans*); Kumanonada, 200 fathoms (on the gastropod shell *Buccinum suruganum*).

15. *Heteralepas* (*Paralepas*) *xenophorae* (ANNANDALE)

(Fig. 3)

Alepas xenophorae ANNANDALE, 1906, p. 399 (type locality: off S. W. coast of India, in 185 fathoms, on shell of living *Xenophora*).

Heteralepas (*Paralepas*) *typica* NILSSON-CANTELL, 1921, p. 250, fig. 45; pl. 3, fig. 3 (type locality: Okinose Bank, Sagami Bay).

? *Heteralepas* (*Paralepas*) *scutiger*[1] BROCH, 1922, p. 284, fig. 36 (type locality: Sagami Bay, in 400 fathoms); BROCH, 1931, p. 41.

Heteralepas (*Paralepas*) *xenophorae* HIRO, 1937a, p. 73, fig. 61 (synonymy).

Material. Not represented in the collection of the Biological Laboratory of the Imperial Household.

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1) In a foot-note (p. 235) of the same paper, BROCH mentioned that "Possibly identical with *Heteralepas* (*Paralepas*) *typica* NILSSON-CANTELL", but later (1931) he regarded as distinct.

Three specimens apparently referable to this species, all from Sagami Bay, are examined. One of them found at Matuwa, off Misaki, 100–200 fathoms is attached to a shell (the name of which is not recorded). The other two were collected at "Misago" Station 13 (between Itô and Hatusima, east of Izu Peninsula, 120–130 m) by Dr. T. SAKAI in June, 1934, and found as attached to a living shell *Xenophora pallidula* (REEVE).

Description. The measurements of these specimens are as follows:

Specimen from	Matuwa	Between Itô and Hatusima	
Length of capitulum	5.5 mm	6.0 mm	5.0 mm
Breadth of capitulum	4.3	5.3	3.3
Length of peduncle	3.0	3.3	4.0
Breadth of peduncle	2.0	1.9	1.9
Length of orifice	2.0	2.0	1.5

Capitulum almost globular, somewhat compressed laterally only in the upper part, but without any trace of carinal ridge or crest. Apex in lateral view moderately angular, not so rounded as in the preceding species. Orifice not protuberant occupying about one-third as long as capitulum, with puckered lips. Integument white, nearly translucent, with shallow, more or less reticulated stripes on the surface; this striation may be due to the contraction of musculature by the preservation in alcohol for many years. Apparently no scuta.

Peduncle shorter than capitulum, cylindrical and irregularly wrinkled.

For examination of the internal parts, a specimen from Matuwa was dissected.

Cirri are relatively short and not curled. The numbers of segments in the rami of the cirri are:

$$\overbrace{9\quad 9}^{\text{I}}\qquad \overbrace{17\quad 17}^{\text{II}}\qquad \overbrace{18\quad 17}^{\text{III}}\qquad \overbrace{18\quad —}^{\text{IV}}\qquad \overbrace{18\quad 18}^{\text{V}}\qquad \overbrace{18\quad 18}^{\text{VI}}$$

Each segment exhibits the armature typical of the subgenus *Paralepas.* At the base of cirrus I a well developed digitiform filamentary appendage is situated. Caudal appendage is a little longer than the protopodite of cirrus VI, consisting of 10 segments. Penis comparatively short, stout, tapering and annulated all over, except on the proximal and distal parts, and planted with long hairs sparsely.

Mouth-parts are also typical of the subgenus *Paralepas.* Labrum with a single row of small denticles along the inner edge. Palpus conical, with bristles arranged along the inner edge.

Mandible with 4 teeth, of which the fourth at the lower angle. Inferior edge of the lower three teeth is strongly pectinated, while superior edge of the second and fourth only slightly pectinated.

Maxilla I with a distinct notch below the uppermost one large and two smaller spines; below the notch the cutting edge is densely armed with spines of irregular length.

Maxilla II with a continuous row of rather short bristles along the frontal edge and a tuft of longer bristles at the posterior upper edge, leaving a wide gap between.

Range. Known only from the localities listed above, usually on shell of living *Xenophora.*

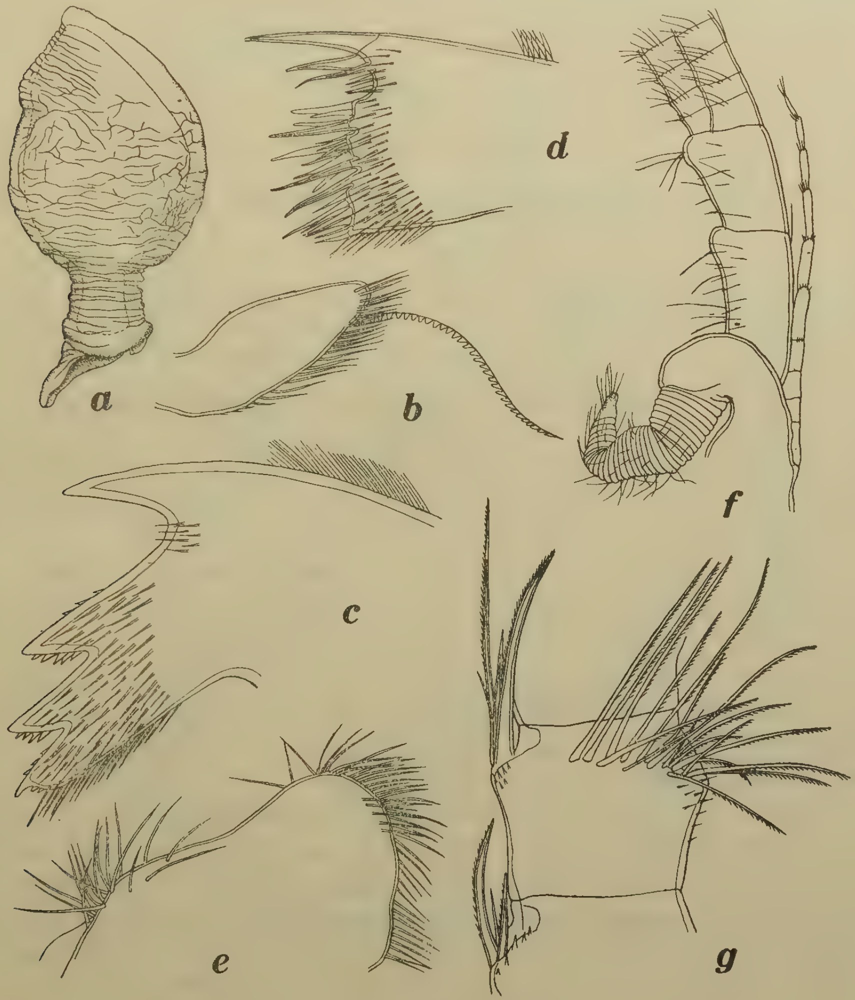

Fig. 3. *Heteralepas* (*Paralepas*) *xenophorae* (ANNANDALE).
a, Animal, lateral view. *b*, Labrum and palpus. *c*, Mandible. *d*, Maxilla I. *e*, Maxilla II. *f*, Basal part of cirrus VI, with caudal appendage and penis. *g*, Intermediate segment of cirrus VI. (*a* ×6, *b–e* ×70, *f* ×33, *g* ×145)

Remarks. The present specimens must in my opinion be referred to *Heteralepas* (*Paralepas*) *xenophorae* originally described from the southwest coast of India, both being found on the shell of living *Xenophora.* NILSSON-CANTELL (1921) described *H.* (*P.*) *typica* and BROCH (1922) also *H.* (*P*) *scutiger*, both from Sagami Bay as separate species, although recognizing a close affinity of their species with ANNANDALE's species. The fact that NILSSON-CANTELL's specimen was also taken from a shell of *Xenophora* (as inferred from the photograph given by him) in Sagami Bay suggests that they are possibly identical. All the morphological characters do not differ so much that they must be kept apart.

Family Poecilamatidae

(=Fam. Trilasmatidae)

16. *Megalasma (Megalasma) striatum* HOEK

(Fig. 4)

Megalasma striatum HOEK, 1883, p. 51, pl. 2, figs. 5–9; pl. 7, figs. 8–9 (type locality: Philippine Archipelago, 210 m, on *Echinus*); HOEK, 1907, p. 31; BROCH, 1922, p. 270, figs. 29–30; BROCH, 1931, p. 33; HIRO, 1937a, p. 99, fig. 81; NILSSON-CANTELL, 1938, p. 29.

Material. Not represented in the collection of the Biological Laboratory of the Imperial Household.

A specimen deposited in the collection of the Seto Marine Biological Laboratory registered as No. Rare 83 was taken at west of Yodomi, Okinose Bank, off Misaki, between 80–280 fathoms.

Description. The specimen which is figured already in HIRO's book (1937a, p. 99, fig. 81) measures: Length of capitulum 10 mm, breadth of capitulum 5 mm, length of peduncle about 1 mm.

This very little known species lacks almost the description of the internal parts. Although the general structure is almost alike that in other species as given by PILSBRY (1907b), HOEK (1907) and CALMAN (1919), the following supplementary account may be helpful for future comparison.

All the cirri are relatively long and slender, each segment having four pairs of large and one pair of small bristles on the frontal face. Cirrus I is widely separated from the remaining cirri and on dorsum of the prosoma near the posterior end, a single pair of rather long filamentary appendages are situated together. The caudal appendage is unique in filiform, shorter than half the length of the basal segment of the protopodite of cirrus VI. The numbers of segments in the cirri are:

I		II		III		IV		V		VI	
10	8	15	18	19	19	20	21	17	18	20	19

Penis is long, stout and bears long hairs.

Of the mouth-parts, labrum has distinct denticles arranged in a row along the inner edge. Palpus narrowly conical, with bristles on the inner edge, becoming longer distally.

Mandible with four teeth and a shorter lower angle.

Maxilla I with a deep notch below the upper large spines. Below the notch the frontal edge projects and is closely spinose, as usual.

Maxilla II quadrangular in lateral view, bearing long bristles along the whole edge.

Range. Indian Ocean, Malay Archipelago, Japan. On spines of echinoids.

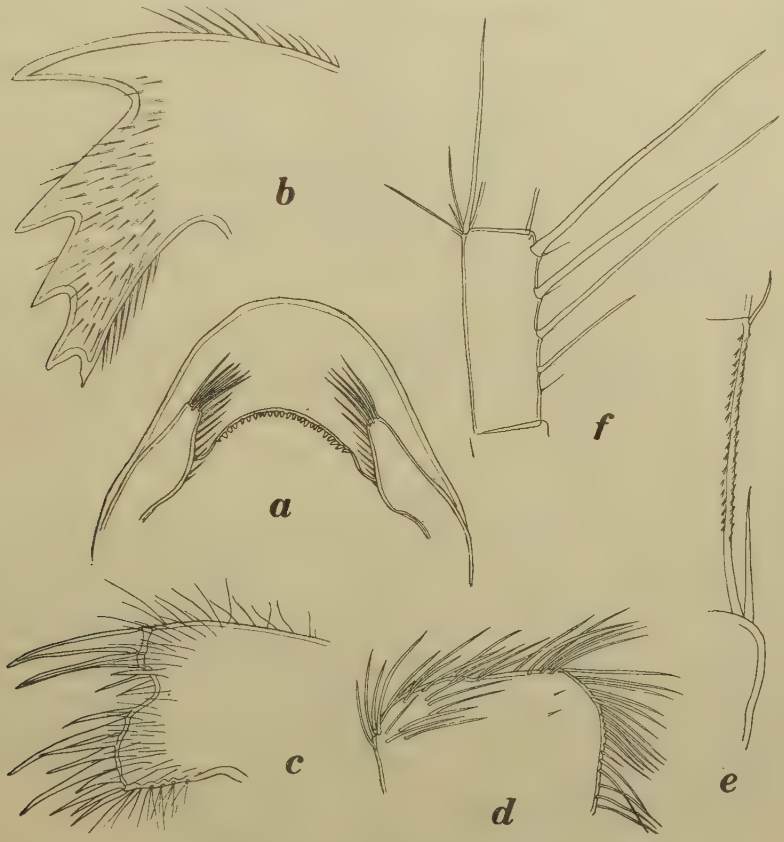

Fig. 4. *Megalasma* (*Megalasma*) *striatum* Hoek.
a, Labrum and palpi. *b*, Mandible. *c*, Maxilla I. *d*, Maxilla II. *e*, Caudal appendage. *f*, Intermediate segment of cirrus VI.
(*a–d* ×70, *e* ×60, *f* ×55)

BALANOMORPHA

Family Balanidae

Subfamily Balaninae

17. *Balauus tintinnabulum volcano* Pilsbry

Material. Crust. No. 147. 17 specimens, together with *Tetraclita squamosa*. Teidohama, Mitune-mura, Hatizyô Island. 29–V–1929.

Range. Southern coast of Japan, from Bôsô Peninsula to Tanegasima south of Kyusyu. Lowest of intertidal.

18. *Balanus tintinnabulum rosa* PILSBRY

Material. Crust. No. 1137. 7 specimens attached to a buoy. Off Issiki, Hayama. 14–VIII–1956.

Range. All the seas around Japan, from Mutu Bay to Formosa. Subtidal.

19. *Balanus poecilotheca* KRÜGER

Balanus poecilotheca KRÜGER, 1911, p. 48, pl. 1, figs. 2c–e; pl. 3, fig. 32 (type locality: Okinose Bank, Sagami Bay); PILSBRY, 1916, p. 110; BARNARD, 1924, p. 71.

Balanus amphitrite poecilotheca HIRO, 1937b. p. 435, figs. 22–23 (synonymy).

Material. Crust. No. 1127. 4 specimens attached to a dead stem of antipatharians, together with *Heteralepas* (*Heteralepas*) *japonica*, all covered with a stoloniferan *Clavularia mikado* UTINOMI. Between Maruyama-dasi and Kannonzuka-dasi, 60–80 m. 14–VIII–1956.

Range. Japan, Malay Archipelago, South Africa, 20–290 m. Usually on dead gorgonian stems.

Remarks. Earlier I have pointed out that *Balanus amphitrite poecilosculpta* which was described by BROCH (1931) and later by NILSSON-CANTELL (1934) from South China and Malay Archipelago, seems identical with this species and regarded it as a subspecies of *Balanus amphitrite.* Having now studied a long series of the latter, I have reconsidered the matter and believe that KRÜGER and PILSBRY are right in separating it from various forms of *B. amphitrite* as a distinct species. The latter is mostly intertidal in habitat and rather larger in size; besides, the color markings and sculpture on the shell are quite different and rather more related to those of deep-water forms like *B. trigonus*.

20. *Balanus trigonus* DARWIN

Material. Crust. No. 1137. 9 specimens on *Balanus tintinnabulum rosa.* Off Issiki, Hayama. 14–VII–1956.

Range. Widespread in Pacific, Indian and Atlantic Oceans.

21. *Balanus rostratus rostratus* HOEK

Material. Crust. No. 1323. 10 specimens (mostly 20 mm high) attached to stones. Kannonzuka-dasi, Amadaiba, 60 m. 19–VII–1957.

Crust. No. 1338. 12 specimens (9–19 mm in diameter) clustered on a gastropod shell *Bursa dunkeri* KURODA. Maruyama-dasi, Amadaiba, 65 m. 23–VII–1957.

Range. Northern Pacific, from Puget Sound to Japan through Alaska. In Japanese waters, it extends as far south as Sagami Bay, but penetrates further into Seto Inland Sea probably through the Sea of Japan, as hitherto not found in the area of Kurosio current except northwards.

22. *Balanus rostratus apertus* PILSBRY

(Fig. 5)

Balanus rostratus apertus PILSBRY, 1911, p. 74, fig. 6; pl. 12, figs. 4, 7; pl. 13, figs. 1, 2, 8, 9 (type locality: Bering Sea in 43 fathoms); PILSBRY, 1916, p. 144, pl. 36, figs. 3–6; pl. 37, figs. 1–1c.

Balanus rostratus var. *spiniferus* NILSSON-CANTELL, 1932, p. 20, figs. 8–9; pl. 1, fig. 4 (type locality: Kobe, Japan). New combination.

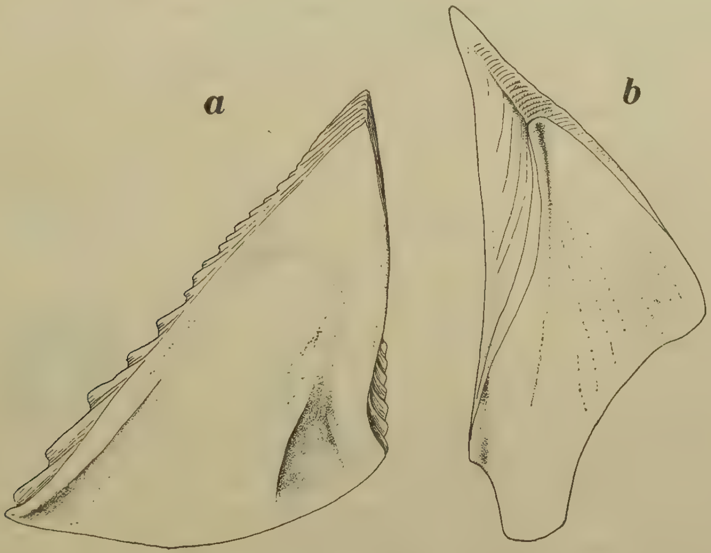

Fig. 5. *Balanus rostratus apertus* PILSBRY.
a, Scutum, inner view. *b*, Tergum, inner view. (×9)

Material. Crust. No. 1217. One specimen, probably imbedded in sponge. Kannonzuka-dasi, Amadaiba, 70–75 m. 16–I–1957.

Description and remarks. The single isolated specimen is snow white, of a conic form curved rostralward, with a relatively small orifice. All the parietes bear a number of acute spines projecting downward, each arranging longitudinally; longest spine exceeds 2 mm in length; growth-lines faintly defined. The radii are wide, with the upper edges almost parallel to the base. They are not so deeply sunken below the parietes as in the typical form. The basis is deeply hollowed but externally quite smooth, with no indication of calcifying together by attachment to any solid object. This suggests its being embedded in sponges.

The spines on the parietes are admirably adapted to keep the shell itself firmly to growing sponges but to keep the orifice freely upward so as to be not buried wholly. This reminds one of spinose species of *Acasta*.

As to the habitat, Pilsbry (1916, p. 147) mentions that "The typical form of *apertus* is almost always on sponge, but sometimes on shells." Nilsson-Cantell (1932)'s var. *spiniferus* recorded from Kobe was also found as embedded in a sponge. In my opinion, however, the difference between *apertus* and *spiniferus* concerning the number of paired bristles on the segments of the cirri is probably due to age of individuals.

The present specimen from Sagami Bay is intermediate in size between the specimens of Pilsbry and of Nilsson-Cantell, as showing in the following measurement.

Carinorostral diameter 18 mm, height of rostrum 10 mm, height of carina (strongly curved) 23 mm, diameter of orifice 7 mm.

The opercular valves, as figured here, resemble closely those of *B. rostratus*; in particular, the tergum is not so narrow as figured for *apertus* as well as *spiniferus*.

The mouth-parts agree fairly well with the descriptions given by the two authors. The numbers of segments in the cirri are given below in comparison with those given by them.

	I		II		III		IV		V		VI	
Diam. 11.5 mm (after Nilsson-Cantell)	12	25	13	15	14	16	36	37	34	35	34	34
Diam. 18 mm (the present specimen)	12	27	16	15	17	17	36	36	—	—	—	—
Diam. 33 mm (after Pilsbry)	15	27	15	19	12	19	35	35	35	35	35	35

The numbers of segments in the cirri are thus not much different irrespective of the size of the shell. Each segment of the posterior longer cirri bears, according to Pilsbry, 6 or 7 pairs of bristles on the frontal side, while according to Nilsson-Cantell, 4 pairs. In the present specimen, however, it bears only 3 pairs in the fourth cirri, the remaining longer ones being lost.

Henry (1940) synonymized Nilsson-Cantell's *spiniferus* and Pilsbry's *heteropus* with subsp. *alaskensis* without any discussion. But it may be improbable.

Range. Alaska and Japan (Kobe). Usually imbedded in sponges.

23. *Balanus calceolus* Darwin

Material. Crust. No. 1337. 2 specimens on a branch of *Melithaea* sp. Maruyama-dasi, Amadaiba, 65 m. 23–VII–1957.

The specimens in the collection of the Seto Marine Biological Laboratory, which were taken at Misaki, are found attached to the stem of *Acalycigorgia irregularis* Kükenthal & Gorzawsky.

Range. West coast of Africa, Mediterranean (?), Indian Ocean, Australia, Malay Archipelago, Japan. On gorgonian stems.

24. *Balanus cymbiformis* DARWIN

Material. Not contained in the collection of the Biological Laboratory of the Imperial Household.

Four specimens of this species attached to the stem of *Melithaea flabellifera* (KÜKENTHAL), taken at Misaki, are now in the collection of the Seto Marine Biological Laboratory.

Range. Indian Ocean, Malay Archipelago, Fiji Islands. On gorgonian stems.

25. *Acasta fenestrata* DARWIN

(Figs. 6–7)

Acasta fenestrata DARWIN, 1854, p. 316, pl. 9, figs. 7a–c (type locality: Philippine Archipelago); WELTNER, 1897, p. 259; WELTNER, 1922, p. 104; NILSSON-CANTELL, 1938, p. 57; HIRO, 1939a, p. 243.

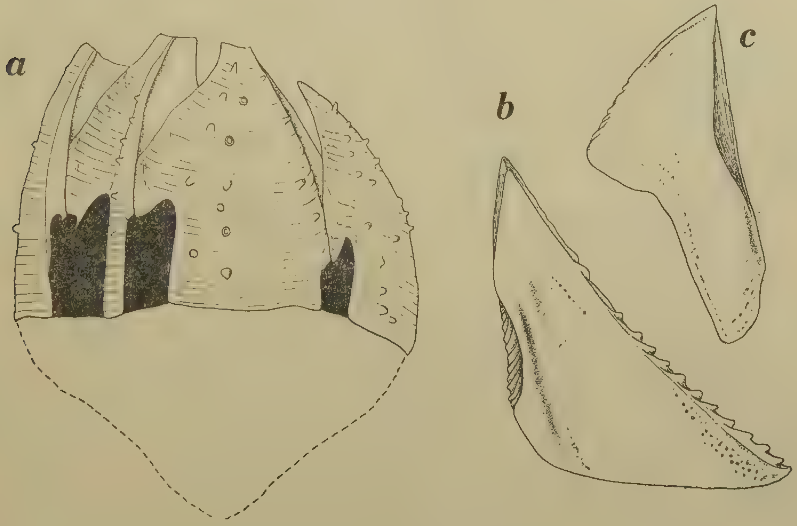

Fig. 6. *Acasta fenestrata* DARWIN.
a, Specimen (1375) in side view. *b*, Scutum, inner view.
c, Tergum, inner view. (×9)

Material. Crust. No. 1324. 4 dead specimens wholly buried in a *Geodia*-like hard tetraxon sponge. Kannonzuka-dasi, Amadaiba, 60 m. 19–VII–1957.

Crust. No. 1375. 2 specimens in soft silicious sponge. Kannonzuka-dasi, Amadaiba, 60–65 m. 29-VII–1957.

Description. This species was first recorded by WELTNER from off Enosima, Sagami Bay and later by the author from the vicinity of Seto, Kii Peninsula.

The general structure of the shell has been fully described by DARWIN, but the internal structure is quite unknown, so that the following detailed description based on this new material may be useful as a supplement.

The shell is firmly connected with the hard sponge tissue by calcareous points studded on the surface and all the compartments are not so tightly articulated together, having a large 'window' inserted between the base of them. So it is very difficult to dissect out intact specimens from the sponge.

The points on the parietes are rather sparsely arranged in longitudinal rows. They are generally small, roundly ended and empty, sometimes with hollowed tip; but as far as it could be observed, this 'hollow' does not penetrate the compartment itself.

The compartments are externally striped transversely parallel to the basal margin, but not on the alae. The radii are well developed with delicate striations running on the cross; below the radii, the edges of the compartments themselves are deeply hollowed out, indicating a wide gap (or window) between the opposed edges of the walls. The size of these windows may be variable in different specimens, but that between the carina and carinal latus seems to be largest. Thus the paries of the carinal latus extended down to the basis is narrowest among all compartments, only about 1/8 as wide as the lateral compartment at base.

All the parietes are internally quite smooth down to the basis, and not canaliculated. Also the base is not canaliculated, usually cup-shaped and brittle.

Measurements of four specimens are:

Carinorostral diameter	8.5 mm	7.0 mm	5.5 mm	4.5 mm
Height of compartment	5.5	5.5	3.4	6.0
Depth of basal cup	3.5	6.0	1.0	?

Scutum is rather thick, triangular and a little higher than broad. The external surface is slightly concave, marked with strong growth-lines, crossed by faint radiating stripes. Internally there is a deep but narrow longitudinal furrow between the articular and adductor ridges both of which are low. The pit for the adductor muscle is only faintly indicated.

Tergum is slightly furrowed along the line of spur. The scutal margin is straight, with a low articular ridge. The spur is rather long, about half as wide as the valve and roundly ended; its carinal margin is straight and parallel to the scutal margin of the valve itself. Crests for the depressor muscles are only slightly indicated.

Numbers of segments of the cirri in a smallest but perfect specimen dissected are as follows:

$$\underbrace{24\quad 8}^{\text{I}}\qquad \overbrace{13\quad 12}^{\text{II}}\qquad \overbrace{15\quad 13}^{\text{III}}\qquad \overbrace{18\quad 22}^{\text{IV}}\qquad \overbrace{28\quad 27}^{\text{V}}\qquad \overbrace{32\quad 30}^{\text{VI}}$$

In cirrus I, the anterior ramus is three times as long as the posterior. In cirrus II and III, the anterior ramus is a little longer than the posterior. Whereas the other posterior cirri have each the rami of subequal length.

The armature of the cirri is peculiar. Cirrus IV bears 1–3 large hooks on each segment of the anterior ramus, except on the proximal and distal parts, but none on the protopodite. In all cirri, the protopodite is considerably long; in cirrus I–III, its basal segment bears long feathered bristles, while in cirrus IV–VI the dorsal margin of both the segments is fringed with fine hairs all throughout.

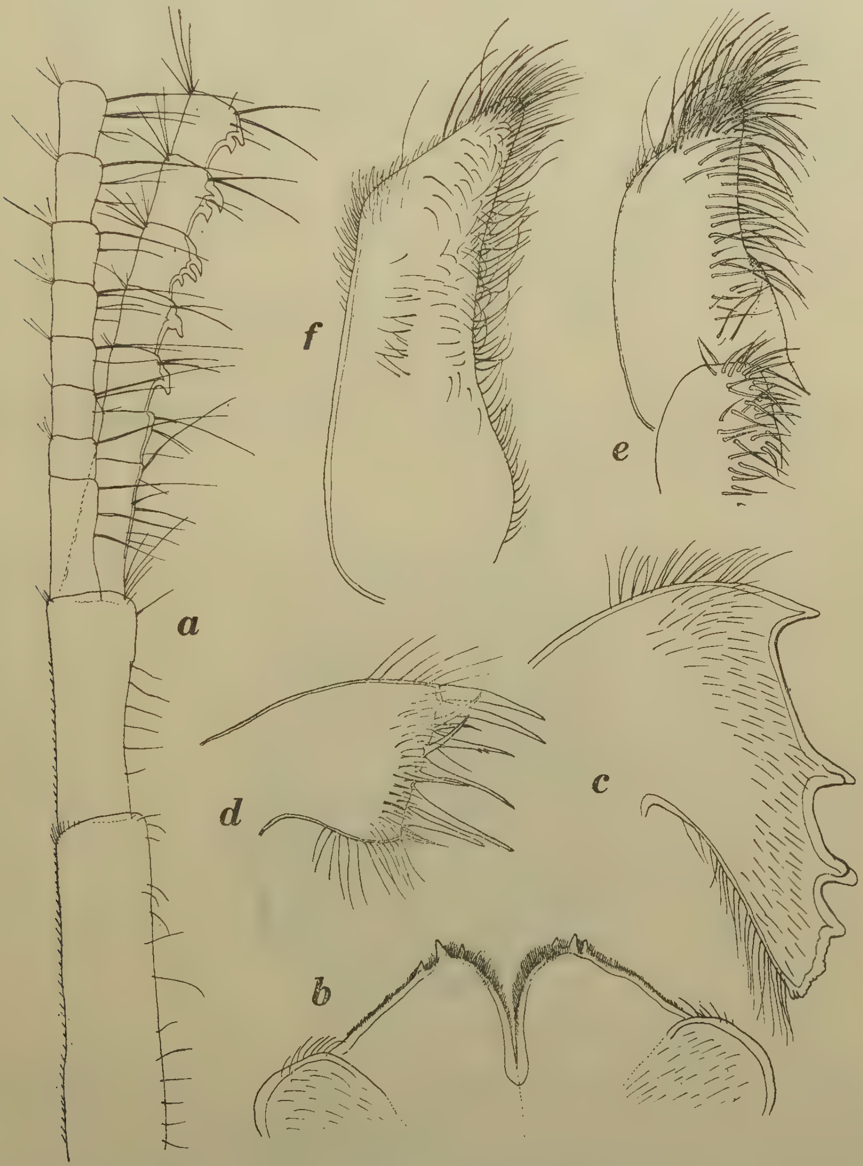

Fig. 7. *Acasta fenestrata* Darwin.

a, Basal part of cirrus IV. *b*, Labrum. *c*, Mandible. *d*, Maxilla I. *e*, Maxilla II. *f*, Palpus. (*a* ×55, *b*–*f* ×80)

The penis is very long and annulated all over.

Of the mouth-parts the labrum is the most peculiar; its cutting edge is unusually very villose and provided with 3 large denticles on each side of the wide median notch. Palpus is rhomboidal, with the straight distal margin narrowest and long bristles all around the inner margin.

Mandible has four distinct teeth of which the second and third are bifid. Below the fourth tooth the edge is finely serrated, with an indication of a diminutive denticle.

Maxilla I has a straight cutting edge without any notch. There are two large upper spines followed by a row of some six smaller spines, and on the lower part again two large spines and two tiny ones.

Maxilla II consists of two lobes, the upper elongate and the lower short oval; both are clothed with numerous bristles on the inner surface.

Range. Japan, Philippines, Indian Ocean.

26. *Acasta spongites* (POLI)

(Figs. 8–10)

Acasta spongites DARWIN, 1854, p. 308, pl. 9, figs. 1a–d; WELTNER, 1897, p. 259; PILSBRY, 1916, p. 242, fig. 77; BARNARD, 1924, p. 80; KOLOSVÁRY, 1947, p. 22.

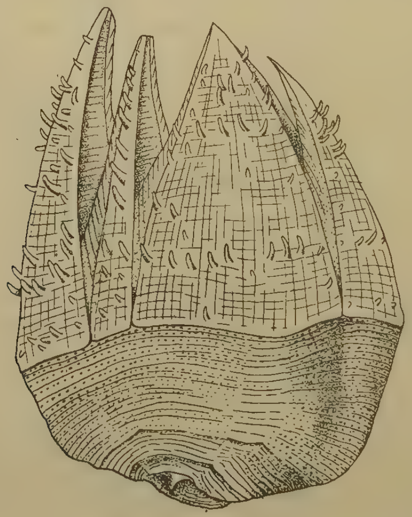

Fig. 8. *Acasta spongites* (POLI). (×7)

Material. Crust. No. 1432. 14 specimens imbedded in a *Hircinia*-like sponge. Between Kannonzuka-dasi and Maruyama-dasi, 60 m. 14–II–1958.

Description. This species was first recorded by WELTNER (1897) from Japan based on HILGENDORF's collection, but so far has not been recorded, so that its actual existence has not been confirmed for a long time.

The shape is usually cup-like, but variable mainly in the depth of the basal cup, as often noticed by various authors. The colour is white, or of a pinkish hue chiefly in the lower part of the shell. The surface of the compartments is furnished with many upturned, solid spines, the arrangement of which is generally irregular. The orifice is rather large and deeply notched owing to the strong obliquity of the radii and alae. The radii are well developed, but not so wide as the alae which are more sunken than the radii.

The parietes are well developed and adjoin each other basally. Carinal latus is about 1/5 to 1/6 as wide as the lateral compartments. Carina is longest but a little narrower than rostrum. In all compartments the sheath is a little more than half so long as the compartment. Below the sheath, the inside of the parietes is slightly ribbed.

The basal cup is generally of a regular cup-like form, and about 2/3 as deep as the shell is high; sometimes it is shallower or moderately flattened, and often distorted. It is wholly or partly penetrated by small pores arranged in one row between the transverse growth ridges parallel with the brim of the cup. All the shells and basal cup are covered by a thin cuticle.

Measurements of some specimens in millimeters:

Carino-rostral diameter	8.3	6.8	6.9	7.2	6.0
Total height	11.0	10.6	9.5	7.3	6.3

Scutum is moderately thick, higher than wide, and has prominent growth ridges traversed by strong radiating stripes with even fade away nearer the base; the margins of these ridges are not crenate but fringed closely with hairs. The articular ridge is prominent, and the adductor ridge is rather well defined as a short mound separating the depressions for the adductor muscle and for the lateral depressor muscle.

Tergum is narrowly triangular, with a beaked apex. The spur is separated from the basiscutal angle by a narrow interspace, somewhat narrower than 1/3 the entire basal breadth of the valve, and as broad as long; a flat spur-fasciole well bounded by lines runs from the apex to the truncated end. The articular ridge is rather high, but crests for the depressor muscles are feebly developed. The growth ridges of the outer surface, except on the spur-fasciole, are fringed with hairs.

Cirri of a dissected specimen show the following numbers of segments:

I		II		III		IV		V		VI	
16	6	10	7	13	12	20	25	28	30	32	32

In cirrus I, the anterior ramus is nearly thrice as long as the posterior. In cirrus II, the anterior ramus is a little longer than the posterior. In cirrus III, both the rami are subequal in length. In cirrus IV, the anterior ramus is shorter and rather more slender than the posterior; the regular pairs of bristles are rather crowded together in the upper part of each segment and moreover a few erect spinules, somewhat arranged transversely, are planted on the ventro-distal part in both the rami. In the other cirri, both the rami are subequal and each segment bears three or four pairs of bristles on the ventral surface.

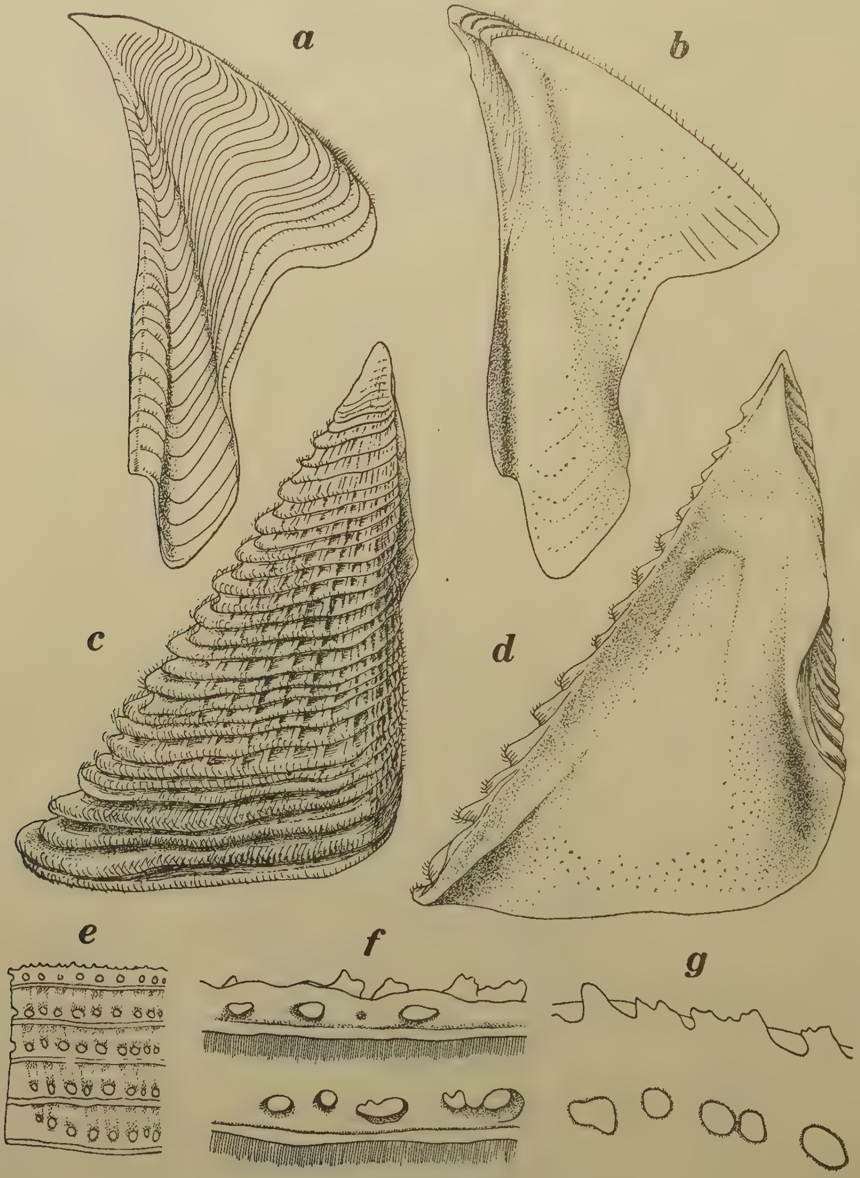

Fig. 9. *Acasta spongites* (POLI).

a, Tergum, outer view. *b*, Tergum, inner view. *c*, Scutum, outer view. *d*, Scutum, inner view. *e*, A part of basal cup, showing the cancellated structure, outer view *f*, Outer view of upper edge of basal cup, enlarged. *g*, Inner view of upper edge of basal cup, enlarged. (*a–e* ×18, *f–g* ×53)

The penis is long, annulated all over and hairy; no basi-dorsal point is present.

Mouth-parts: Labrum with one or two denticles on each side of the median notch.

Mandible with four large teeth and a rounded lower angle.

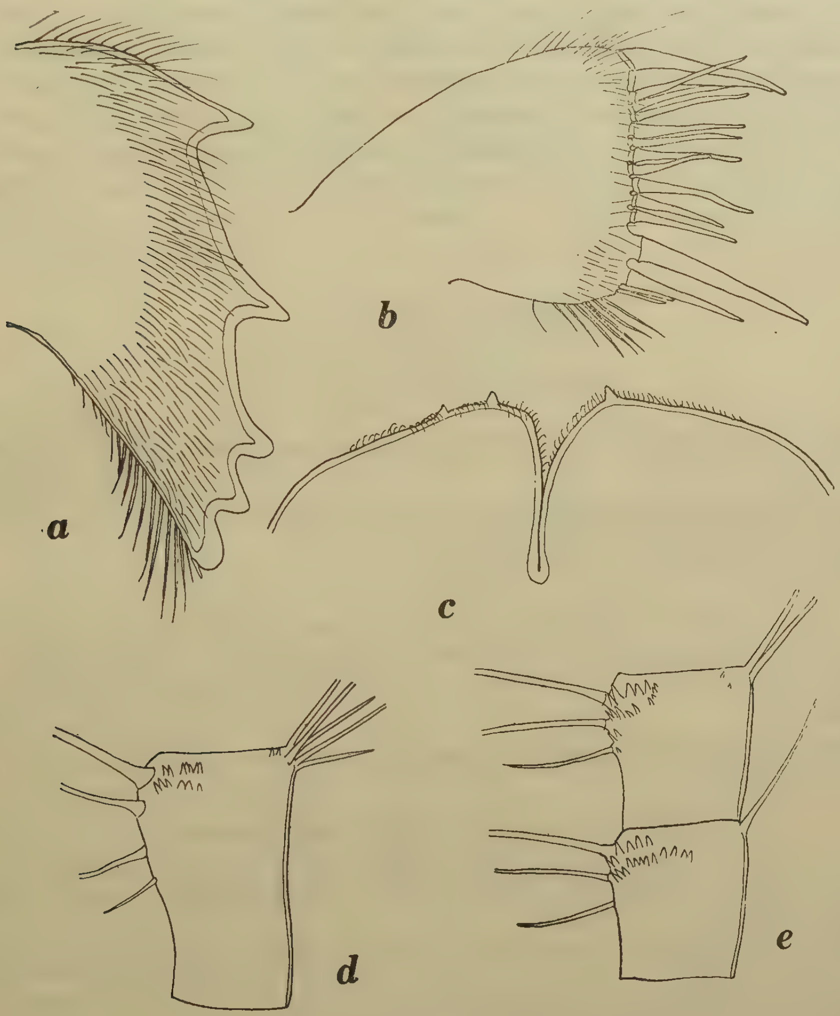

Fig. 10. *Acasta spongites* (Poli).
a, Mandible. *b*, Maxilla I. *c*, Labrum. *d*, Median segment of posterior ramus of cirrus IV. *e*, Median segments of anterior ramus of cirrus IV.
(*a–c* ×97, *d–e* ×150)

Maxilla I has a straight cutting edge without any notch. There are two large upper spines followed by a row of ten smaller spines, and on the lower part again one large and one small spines, and terminally a few spinules.

Maxilla II is bilobed and clothed with numerous bristles on the inner surface.

Range. North Atlantic, from British Islands to the Mediterranean; South Africa; western part of Indian Ocean; Japan (Hakodate, Sagami Bay).

Remarks. According to my former procedure (HIRO, 1937b), this species belongs to the group of 'A–type', but concerning the armature of cirrus IV it may be reckoned as one of special section of BROCH's '*Eu-Acasta* group', indicating a close affinity with *Conopea*, a subgenus of *Balanus*. *Acasta laevigata* GRAY, *A. semota* HIRO and *A. coriobasis* BROCH have also a similar armature in the fourth cirri. *Acasta japonica* PILSBRY (1911), has been often treated as a subspecies or variety of *Acasta spongites* even now. However, it is clearly distinct as species, as pointed out already by PILSBRY (1916), the shape of the tergum being quite different and the perforation of the basal shell being not met with. Moreover, each segment of the anterior ramus in cirrus IV bears 2 or 3 large hook-like spines, in a specimen at hand dissected.

Subfamily Tetraclitinae

27. *Tetraclita squamosa viridis* DARWIN

Material. Crust. No. 147. 2 specimens. Teidohama, Mitune-mura, Hatizyô Island. 29–V–1929.

Range. Widespread in the Indo-Pacific, as far north as Sagami Bay. Also recorded from West Africa and from Panama.

28. *Tetraclita squamosa japonica* PILSBRY

Material. Crust. No. 147. 3 specimens. Teidohama, Mitune-mura, Hatizyô Island. 29–V–1929.

Range. Japan and Korea, from Tugaru Strait to Ryukyu Islands.

29. *Tetraclita* (*Tetraclitella*) *darwini* PILSBRY

Material. Not contained in the collection of the Biological Laboratory of the Imperial Household.

But this is occasionally found under stones in the intertidal zone all along the coast of Sagami Bay.

Range. Japan and Formosa.

Previous Records of Cirripedia Thoracica from Sagami Bay and Its Adjacent Seas

The littoral sessile fauna as well as the deep-sea fauna in Sagami Bay is still imperfectly known. The following list of the Cirripedia Thoracica previously recorded from Sagami Bay and its adjacent areas, including Suruga Bay, Izu Seven Islands and Bôsô Peninsula, is mainly derived from the works of WELTNER (1897, 1922), PILSBRY (1907a, 1916), KRÜGER (1911, 1912), NILSSON-CANTELL (1921), BROCH (1922) and HIRO (1931–1938), based on the collections made by HILGENDORF, DÖDERLEIN, LOOMIS, HABERER, DOFLEIN, BOCK, MORTENSEN and by myself respectively. A comparison with the list given in my previous two papers (HIRO, 1937b and 1939a) dealing with the cirripeds found in the vicinity of Seto of Kii Peninsula show that the number of species is smaller for the present, but will probably increase more by further extensive collecting. The species comprised in the collection of the Biological Laboratory of the Imperial Household, as well as those in the collection of the Seto Marine Biological Laboratory not earlier reported on from that district, are preceded in the list by an asterisk *.

LEPADOMORPHA

Scalpellidae

Mitella mitella (LINNAEUS)
KRÜGER 1911; NILSSON-CANTELL 1921 (as *Pollicipes mitella*); HIRO 1932b.

**Calantica eos* (PILSBRY)
PILSBRY 1907a (off Osezaki, Suruga Bay, as *Scalpellum* (*Calantica*) *eos*); HIRO 1932a (as *C. eos longisquama*); WELTNER 1922 (? as *Scalpellum* (*Calantica*) *studeri*); HIRO 1937a.

Calantica krügeri HIRO
KRÜGER 1911 (as *C. trispinosa*); WELTNER 1922 (as *Scalpellum* (*Calantica*) *trispinosum*; HIRO 1932a, 1937a.

**Smilium scorpio* (AURIVILLIUS)
KRÜGER 1911 (as *Scalpellum sexcornutum* PILSBRY); HIRO 1932a, 1933a, 1937a (as *Calantica scorpio*).

**Smilium acutum* (HOEK)
NILSSON-CANTELL 1921 (as *Scalpellum* (*Smilium*) *acutum*).

**Pisiscalpellum withersi* UTINOMI
UTINOMI 1958.

Scalpellum stearnsi PILSBRY
PILSBRY 1890, 1907a, 1911 (Seno-umi, Suruga Bay); KRÜGER 1911; NILSSON-CANTELL 1921; WELTNER 1922; BROCH 1922, 1931.

Scalpellum rubrum PILSBRY
BROCH 1922; HIRO 1937a.

**Scalpellum vitreum* HOEK
HOEK 1883 (off Bôsô Peninsula); HIRO 1937a.

**Scalpellum nipponense* PILSBRY
PILSBRY 1907a; NILSSON-CANTELL 1921 (as *S. intermedium*); BROCH 1931; HIRO 1933a, 1937a.

Scalpellum formosum HOEK

NILSSON-CANTELL 1921; WELTNER 1922 (as *S. formosum* PILSBRY), HIRO 1937a.

Scalpellum condensum NILSSON-CANTELL

NILSSON-CANTELL 1921; HIRO 1937a.

Scalpellum uniarticulatum NILSSON-CANTELL

NILSSON-CANTEL 1921; HIRO 1933a, 1937a.

Oxynaspididae

Oxynaspis pacifica HIRO

HIRO 1931.

**Oxynaspis celata* DARWIN

UTINOMI (this paper).

Lepadidae

**Lepas anatifera* LINNAEUS

KRÜGER 1911; WELTNER 1922; BROCH 1922.

**Lepas anserifera* LINNAEUS

UTINOMI (this paper).

**Lepas hilli* (LEACH)

HIRO 1937b; UTINOMI (this paper).

**Lepas fascicularis* ELLIS et SOLANDER

UTINOMI (this paper).

Conchoderma virgatum hunteri (OWEN)

KRÜGER 1911 (also as var. *japonica*), 1912.

**Alepas pacifica* PILSBRY

UTINOMI (this paper).

Heteralepadidae

**Heteralepas (Heteralepas) japonica* (AURIVILLIUS)

KRÜGER 1911 (also as *H. (H.) indica* and *H. (H.) japonica* var. *alba*); BROCH 1922.

Heteralepas (Heteralepas) quadrata (AURIVILLIUS)

KRÜGER 1911, 1912; NILSSON-CANTELL 1921; HIRO 1932b.

**Heteralepas (Paralepas) xenophorae* (ANNANDALE)

NILSSON-CANTELL 1921 (as *H. (P.) typica*); BROCH 1922 (? as *H. (P.) scutiger*); HIRO 1937a.

**Heteralepas (Paralepas) globosa* HIRO

UTINOMI (this paper).

Heteralepas (Paralepas) tuberosa NILSSON-CANTELL

NILSSON-CANTELL 1932; HIRO 1937a.

Heteralepas (*Paralepas*) *rosea* Hiro
Krüger 1911 (as *H.* (*P.*) *pedunculata*); Nilsson-Cantell 1921 (as *H.* (*P.*) *pedunculata* ?); Hiro 1939a.

Koleolepadidae

Koleolepas avis (Hiro)
Hiro 1931 (as *Heteralepas* (*H.*) *avis*); Hiro 1933b, 1937a.

Malacolepadidae

Malacolepas conchicola Hiro
Hiro 1933b, 1937a.

Poecilasmatidae

Poecilasma kaempferi Darwin
Darwin 1851; Weltner 1897, 1922; Pilsbry 1907a; Krüger 1911 (also as var. *litum* and *dubium*); Broch 1922.
Temnaspis amygdalum (Aurivillius)
Hiro 1937a (as *Trilasmis* (*Temnaspis*) *amygdalum*).
Octolasmis aymonini (Lessona et Tapparone Canefri)
Lessona et Tapparone-Canefri 1874; Weltner 1897 (as *Dichelaspis aymonini*); Weltner 1922 (as *Dichelaspis trigona*); Krüger 1911; Hiro 1937a, b.
Octolasmis orthogonia (Darwin)
Hiro 1937a.
Octolasmis weberi pennatulae Hiro
Krüger 1911 (as *Octolasmis weberi*); Hiro 1937a, b.
**Megalasma* (*Megalasma*) *striatum* Hoek
Hiro 1937a; Utinomi (this paper).

BALANOMORPHA

Chthamalidae

Octomeris brunnea Darwin
Hiro 1932b (Miyake-zima).
Pachylasma crinoidophilum Pilsbry
Nilsson-Cantell 1932.
Hexelasma callistoderma (Pilsbry)
Pilsbry 1911 (Suruga Bay, as *Balanus callistoderma*); Krüger 1911 (as *Balanus corolliformis*); Pilsbry 1916 (Suruga Bay).

Chthamalus challengeri HOEK
KRÜGER 1911 (also as *Ch. stellatus*); NILSSON-CANTELL 1921; HIRO 1932b (Miyake-zima).

Balanidae—Balaninae

**Balanus tintinnabulum volcano* PILSBRY
KRÜGER 1911 (as *B. tintinnabulum communis*); NILSSON-CANTELL 1927 (? as *B. tintinnabulum peninsularis*).

**Balanus tintinnabulum rosa* PILSBRY
PILSBRY 1916; NILSSON-CANTELL 1932.

Balanus amphitrite communis DARWIN
WELTNER 1897; HIRO 1938.

Balanus amphitrite albicostatus PILSBRY
KRÜGER 1911 (as *B. a. communis*); PILSBRY 1916; NILSSON-CANTELL 1921; HIRO 1938.

Balanus amphitrite krügeri NILSSON-CANTELL
KRÜGER 1911 (as *B. a. niveus*): NILSSON-CANTELL 1932; HIRO 1938.

Balanus amphitrite hawaiiensis BROCH
HIRO 1937b, 1938.

**Balanus poecilotheca* KRÜGER
KRÜGER 1911; HIRO 1938 (as *B. amphitrite poecilotheca*).

**Balanus trigonus* DARWIN
WELTNER 1897; KRÜGER 1911; PILSBRY 1916; NILSSON-CANTELL 1921; BROCH 1922, 1931.

**Balanus rostratus rostratus* HOEK
WELTNER 1897 (as *B. porcatus*); KRÜGER 1911 (as *B. crenatus*); PILSBRY 1911, 1916.

**Balanus rostratus apertus* PILSBRY
UTINOMI (this paper).

Balanus crenatus curviscutum PILSBRY
PILSBRY 1916.

Balanus hesperius nipponensis PILSBRY
PILSBRY 1916.

Balanus krügeri PILSBRY
PILSBRY 1916 (near Osezaki, Suruga Bay); BROCH 1931.

**Balanus calceolus* DARWIN
UTINOMI (this paper).

**Balanus cymbiformis* DARWIN
WELTNER 1897; UTINOMI (this paper).

Balanus scandens PILSBRY
PILSBRY 1916 (off Osezaki, Suruga Bay).

Balanus granulatus HIRO
HIRO 1937b.
Acasta sulcata (LAMARCK)
KRÜGER 1911; HIRO 1937b.
Acasta dofleini KRÜGER
KRÜGER 1911; NILSSON-CANTELL 1921; HIRO 1931 (as *A. aperta*), 1937b.
Acasta denticulata HIRO
HIRO 1931.
**Acasta fenestrata* DARWIN
WELTNER 1897, 1922.
**Acasta spongites* (POLI)
WELTNER 1897.
Pyrgoma cancellatum LEACH
WELTNER 1897 (as *P. cancellatum* var. *japonica*).
Pyrgoma aff. *anglicum* SOWERBY
BROCH 1931.

Balanidae—Tetraclitinae

**Tetraclita squamosa japonica* PILSBRY
KRÜGER 1911 (as *T. porosa nigrescens*); NILSSON-CANTELL 1927 (as *T. porosa japonica*); HIRO 1932b (Miyake-zima).
**Tetraclita squamosa viridis* DARWIN
KRÜGER 1911 (as *T. porosa viridis*).
Tetraclita (*Tetraclitella*) *chinensis* NILSSON-CANTELL
HIRO 1931, 1932b (as *T. purpurascens nipponensis*).
**Tetraclita* (*Tetraclitella*) *darwini* PILSBRY
UTINOMI (this paper).

Balanidae—Chelinibiinae

Chelonibia testudinaria (LINNAEUS)
WELTNER 1897; KRÜGER 1911.
Chelonibia patula (RANZANI)
WELTNER 1897.

LITERATURE

ANNANDALE, N. 1906. Natural history notes from the R. I. M. S. Ship 'Investigator', Capt. T. H. Heming, R. N., commanding. Series III, No. 12. Preliminary report on the Indian stalked barnacles. Ann. Mag. Nat. Hist., Ser. 7, vol. 17, no. 100.

AURIVILLIUS, C. W. 1894. Studien über Cirripeden. Kunglia Sv. Vetensk.-Akad. Handl., Bd. 26, no. 7.

BARNARD, K. H. 1924. Contributions to the Crustacean fauna of the South Africa. 7. Cirripedia. Ann. S. Afr. Mus., vol. 20.

BROCH, Hj. 1924. Papers from Dr. Th. Mortensen's Pacific Expedition 1914-16. X. Studies on Pacific cirripeds. Vidensk. Medd. Dansk naturh. Foren., Bd. 73.

——— 1931. Papers from Dr. Th. Mortensen's Pacific Expedition 1914–16. LVI. Indomalayan Cirripedia. Ibid., Bd. 91.

CALMAN, W. T. 1919. On barnacles of the genus *Megalasma* from deep-sea telegraph-cables. Ann. Mag. Nat. Hist., Ser. 9, vol. 4.

DARWIN, Ch. 1851. A monograph on the sub-class Cirripedia. I. The Lepadidae. Ray Society, London.

——— 1854. A monograph on the sub-class Cirripedia. II. The Balanidae, Verrucidae, etc. Ray Society, London.

HENRY, Dora P. 1940. The Cirripedia of Puget Sound with a key to the species. Univ. Wash. Publ. Oceanogr., vol. 4, no. 1.

HIRO, F. 1931. Notes on some new Cirripedia from Japan. Mem. Coll. Sci. Koyto Imp. Univ., Ser. B, vol. 7, no. 3.

——— 1932a. Report on the Japanese species of the genus *Calantica* (Cirripedia). Annot. Zool. Japon., vol. 13, no. 5.

——— 1932b. On the Cirripedia collected in Sado, Miyake Itrup Islands and Hokkaido. Zool. Mag. (Japan), vol. 44, no. 530. (Japanese.)

——— 1933a. Report on the Cirripedia collected by the surveying ships of the Imperial Fisheries Experimental Station on the continental shelf bordering Japan. Rec. Oceangr. Wks. Jap., vol. 5, no. 1.

——— 1933b. Notes on two interesting pedunculate Cirripeds, *Malacolepas conchicola* n. gen. et sp. and *Koleolepas avis* (Hiro), with remarks on their systematic positions. Mem. Coll. Sci. Kyoto Imp. Univ., Ser. B, vol. 8, no. 3.

——— 1936. Descriptions of three new species of Cirripedia from Japan. Bull. Biogeogr. Soc. Japan, vol. 6, no. 23.

——— 1937a. Order Thoracica I (Cirripedia Pedunculata). Fauna Nipponica, vol. 9, fas. 1, no. 5. Sanseidô, Tokyo. (Japanese.)

——— 1937b. Studies on Cirripedian fauna of Japan. II. Cirripeds found in the vicinity of the Seto Marine Biological Laboratory. Mem. Coll. Sci. Kyoto Imp. Univ., Ser. B, vol. 12, no. 3.

——— 1938. On the Japanese forms of *Balanus amphitrite* Darwin. Zool. Mag. (Japan), vol. 50, no. 6 (Japanese, with English rés.).

——— 1939a. Studies on the Cirripedian fauna of Japan. III. Supplementary notes on the cirripeds found in the vicinity of Seto. Mem. Coll. Sci. Kyoto Imp. Univ., Ser. B, vol. 15, no. 2.

——— 1939b. Studies on the Cirripedian fauna of Japan. IV. Cirripeds of Formosa (Taiwan), with some geographical and ecological remarks on the littoral forms. Ibid., vol. 15, no. 2.

——— 1939c. Studies on the Cirripedian fauna of Japan. V. Cirripeds of the northern part of Honsyû. Sci. Rep. Tôhoku Imp. Univ., Fourth Ser., Biol., vol. 14, nos. 2/3.

HOEK, P. P. C. 1883. Report on the Cirripedia collected by H. M. S. 'Challenger' during the years 1873–76. Rep. Sci. Res. Challenger, Zool., vol. 8. London.

——— 1907. The Cirripedia of the Siboga-Expedition. A. Cirripedia Pedunculata. Siboga-Expeditie, mon, 31a. Leiden.

KRÜGER, P. 1911. Beiträge zur Cirripedienfauna Ostasiens. Abhandl. math phys. Kl. Bayer. Akad. Wiss. II. Suppl. Bd. 6 Abh.

——— 1912. Über ostasiatische Rhizocephalen. Anhang. Über einige interessante Vertreter der Cirripedia Thoracica. Ibid., 8 Abh.

LESSONA et TAPPARONE-CANEFRI 1874. Nota sulla *Macrocheira Kaempferi* Sieb., e sopra una nuova specie del Genre *Dichelaspis*. Atti. della Reale Acad. Sci. Torino, vol. 9.

NILSSON-CANTELL, C. A. 1921. Cirripeden-Studien. Zur Kenntnis der Biologie, Anatomie und Systematik dieser Gruppe. Zool. Bidrag Uppsala, Bd. 7.

——————— 1927. Some barnacles in the British Museum (Nat. Hist.) Proc. Zool. Soc. London, 1927.

——————— 1932. Cirripedien aus Japan. Ark. Zool., Bd. 24A, no. 4.

——————— 1934. Indo-Malayan cirripeds in the Raffles Museum, Singapore. Bull. Raffles Mus., Singapore, no. 9.

——————— 1938. Cirripedes from the Indian Ocean in the collection of the Indian Museum, Calcutta. Mem. Ind. Mus., vol. 13.

PILSBRY, H. A. 1890. Description of a new Japanese *Scalpellum*. Proc. Acad. Nat. Sci. Philad., 1890.

——————— 1907a. The barnacles (Cirripedia) contained in the collections of the U. S. National Museum. U. S. Nat. Mus., Bull. 60.

——————— 1907b. Notes on the cirripede genus *Megalasma*. Proc. Acad. Nat. Sci. Philad., 1907.

——————— 1908. On the classification of Scalpelliform barnacles. Ibid., 1908.

——————— 1911. Barnacles of Japan and Bering Sea. Bull. Bur. Fish., vol. 29.

——————— 1916. The sessile barnacles contained in the U. S. National Museum, including a monograph of the American species. U. S. Nat. Mus., Bull. 93.

UTINOMI, H. (formerly HIRO, F.) 1949. Studies on the Cirripedian fauna of Japan. VI. Cirripeds from Kyusyu and Ryukyu Islands. Publ. Seto Mar. Biol. Lab., vol. 1, no. 2.

——————— 1958. A new stalked cirriped (*Pisiscalpellum withersi* n. gen. et n. sp.) from Sagami Bay and a discussion on its phylogeny. Jap. Jour. Zool., vol. 12, no. 2.

WELTNER, W. 1897. Verzeichnis der bisher beschriebenen recenten Cirripedienarten. Arch. f. Naturg., Jahrg. 1897, Bd. 1.

——————— 1922. Cirripedia der deutschen Tiefsee-Expedition. Wiss. Ergeb. der deutschen Tiefsee-Exped., Bd. 23, Ht. 2. Jena.

CONTRIBUTIONS TO JAPANESE ASCIDIAN FAUNA

XII. SPORADIC MEMORANDA (3)[1]

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With 6 Text-figures

The five species of ascidians described here were all collected from the Japanese waters; three of which are new species, while other two are new to Japanese ascidian fauna. They are:

1.	*Lissoclinum japonicum* n. sp.	Sirahama, Kii
2.	*Echinoclinum verrilli* Van Name	Sagami Bay
3.	*Pseudodistoma fragilis* n. sp.	Sagami Bay
4.	*Distaplia systematica* n. sp.	Sirahama, Kii
5.	*Polycarpa pedata* Herdman	Sirahama, Kii

Among these, the third species *Pseudodistoma fragilis* n. sp. is most interesting in that it bears apparently the appearance of *Pseudodistoma* of Polyclinidae on one hand and at the same time it shows some resemblance with *Distaplia* of Polycitoridae on the other hand, thus it seems to present an intermediate state between the two families.

1. *Lissoclinum japonicum* n. sp.

(Fig. 1)

A single colony was found on the ocean-side of Hatakezima in the vicinity of the Seto Marine Biological Laboratory, Sirahama. It is roughly a small cubic mass, 15 mm ×8 mm in extent and 2.5–3 mm in thickness. The surface of the colony is quite even and grayish purple in colour when it is alive, but turns to grayish tint in preservatives. The inside of the colony is pure white, this is evidently due to the existence of calcareous spicules within the test. There are about forty roundish branchial apertures scattered over the surface, without forming any system; besides two common cloacal apertures which are two or three times as large as branchial apertures. All branchial apertures are small, but very distinct, opened clearly and each fringed with six lobules as shown in 2 of the Text-figure. There are very spacious thoracic lacunae,

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1) Contributions from the Seto Marine Biological Laboratory, No. 311.

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while the abdomens are embedded in the bottom layer. Spicules are distributed evenly and densely throughout the test from the surface to the bottom. They are mostly 21–33 μ in diameter, being 25 μ on an average. They consist of many short and bluntly pointed rays, up to 15–20 in number on the equatorial plane. The purplish pigment is confined to only the superficial layer of the colony. Zooids are dark red when they are alive. Thorax is ca. 1200 μ and abdomen is ca. 920 μ in length; both parts are strongly constricted off from each other and resultantly the neck region is formed very remarkably. Usually thoracic and abdominal buds are formed; the former from the oesophageal region and the latter from the cardiac portion of the mother individual. Branchial aperture six-lobed, each may be subdivided into two or three lobules.

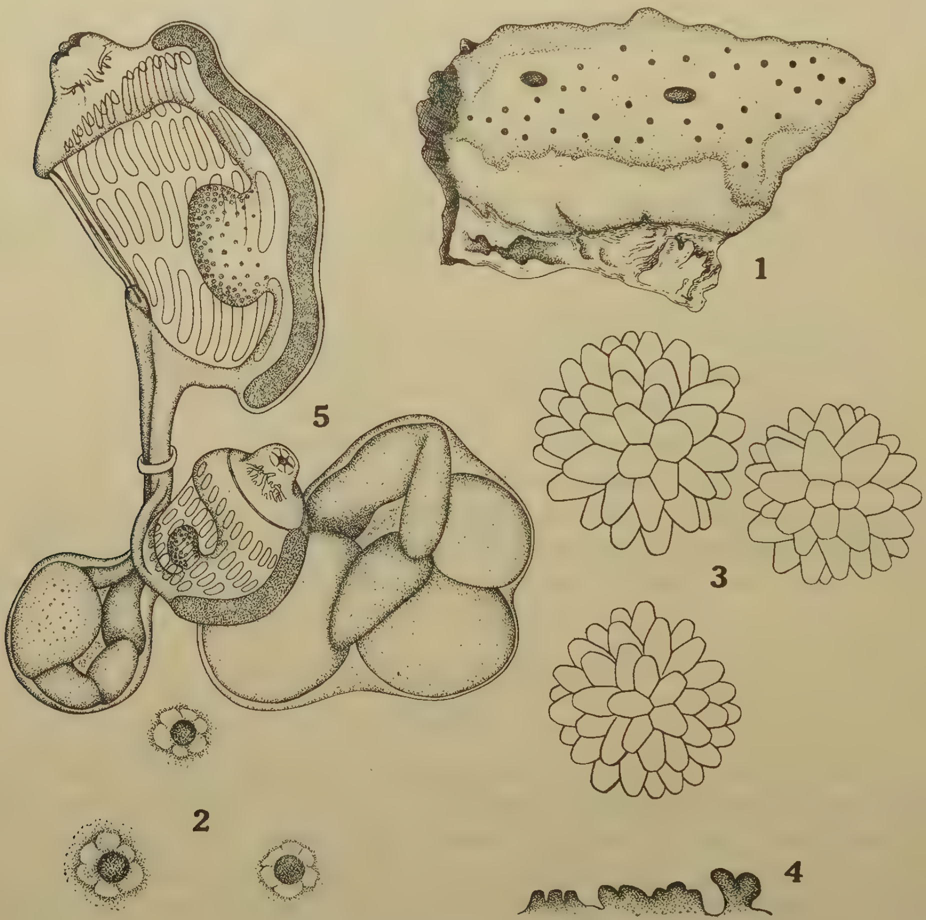


Fig. 1. *Lissoclinum japonicum* n. sp.
1···Colony, × ca. 4; 2···Three branchial apertures, ×23; 3···Calcareous spicules, ×1200; 4···Margin of branchial aperture, magnified; 5···Zooid, ×47.

The atrial aperture is a large opening, the second to the fourth stigmatal rows are nearly wholly exposed; the atrial languet is not observed. The lateral margin of the atrial aperture is protruded on each side towards the out-dorsal side at the level of the third stigmatal row, and there the roundish thoracic organ is formed and many small spicules are contained within it. Stigmatal rows four; anterior two rows contain respectively 10 stigmata on each side, the third eight and the fourth seven. Dorsal languets three, slightly displaced to the left side from the dorso-median line. Tentacles 16, four large and four small ones alternate regularly and every interval is intervened by minute tentacle. A pair of thin longitudinal muscles are running along the dorso-median line of the branchial sac. The anus is situated at the dorso-posterior corner of the thorax and bilobed. The hind-stomach is distinct; the mid-intestine is defined, but very indistinctly. Testicular follicles two.

Remarks: The present species differs apparently from *Lissoclinum fragile* (VAN NAME) in colouration, the latter being snowy white in colour. *Diplosomoides ostrearinum* MICHAELSEN from S. W. Australia and the Great Barrier Reef resembles closely the present species in colouration, but differs from the latter in the form of the atrial aperture which is not so wide as in the present new species.

Diplosomoides caulleryi RITTER & FORSYTH from San Diego Bay and the Juan Fernandez Islands conforms with the present new species in the structure of the colony and in the appearance of the large atrial aperture. The present new species, however, is distinctly separable from any of the above-mentioned three already known species by its characteristic situation and appearance of the thoracic organ.

2. *Echinoclinum verrilli* VAN NAME, 1902

(Fig. 2)

VAN NAME, W. G. (1902): The ascidians of the Bermuda Islands. Trans. Connecticut Acad. Sci., Vol. 11, p. 372, pl. 50 figs. 23–25.

Four minute colonies attached to a polychaete nest collected from the 10 fathoms deep of Miyose-no-takane off Nagai in Sagami Bay. Two larger colonies are respectively 3×2 mm and 6×2 mm in extent and ca. 1.5 mm in thickness. The former contains 15 zooids and the latter 23 zooids. The test is gelatinous, very soft, transparent, and contains white spicules rather densely in the surface layer, but sparsely in the zooidal and lower layers. A single small and oval common cloacal aperture is found on each colony. Spacious thoracic lacunae are developed. The specimens are coloured yellowish white when they are alive. Spicules are very characteristic in their tetrahedron shape, with apices produced into considerably elongated points. They are large and vary, in the present material, from 70 to 120 μ in diameter measured from point to point. The thorax is up to 730 μ and the abdomen attains to nearly the same length, but becomes larger when the testis is fully matured. The neck region is defined very clearly by strong constriction. The branchial aperture

6-lobed, the atrial aperture is a wide opening. The thoracic organ is an elliptical pocket situated approximately at the centre of each lateral side of the thoracic mantle. Stigmatal rows 4, each row contains ca. six stigmata. Tentacles ca. 12. The stomach is globular, the hind-stomach is distinct and elongate, the mid-intestine is very short. Only one testicular lobe is present, the proximal portion of the vas deferens is straight.

Remarks: There is no doubt about the identity of the present specimen with *E. verrilli* VAN NAME which is, however, known only from the West Indies, namely Bermuda and the coastal waters of Florida. So this seems to be the first report from other parts of the world else than the above-mentioned locality. Probably the present species might be distributed widely in the warm-water regions of the world.

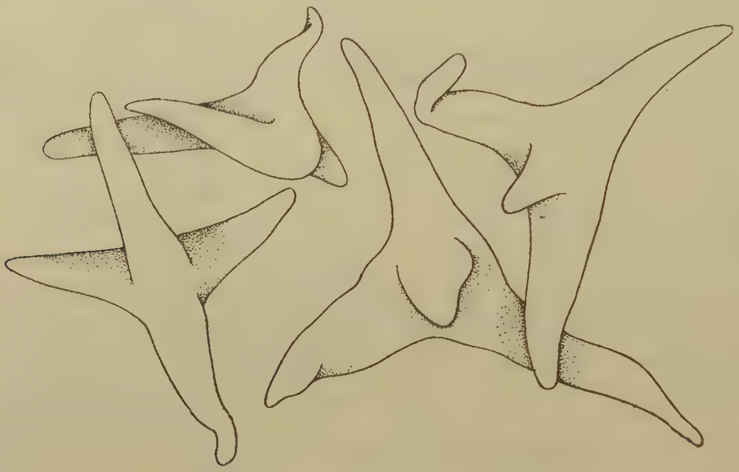


Fig. 2. *Echinoclinum verrilli* VAN NAME. Calcareous spicules, ×626.

3. *Pseudodistoma fragilis* n. sp.

(Fig. 3)

Three colonies in the present material. They were all collected from the ten fathoms deep of Miyose-no-takane off Nagai in Sagami Bay respectively on July 14, 15 and 16, 1955. The colony of July 15 measures 75×85 mm in extent and 2–6 mm in thickness, that of July 16 is 21×30 mm in extent and 3 mm in thickness, while the specimen of July 14 is quite mutilated and zooids are all gone out of the torn test. The test is quite transparent or faintly milky-white and translucent, gelatinous and extremely fragile being easily torn into a mucous substance. The colonies are usually encrusting coarse sands and gravels. Zooids are comparatively large, up to ca. 12 mm when they are expanded. It is about 4.5 mm long when the thorax and the abdomen are measured together, both parts are nearly equal in length; the post-abdomen is not protruded out from the strictly posterior end of the abdomen, but rather from the right posterior side of the intestinal loop and attains to ca. 8 mm in length. There is a very prominent incubatory pouch issued from the right posterior part of the thorax, it may attain to 5 mm in length and contains up to five embryos and ova, which are arranged just as in species of *Distaplia*, namely those of the earlier stages occupy the distal part of the pouch. Both apertures are 6–lobed and opened directly to the exterior. Zooids are greenish yellow in colour when they are alive, but fade to yellowish white in preservatives. They are situated within the

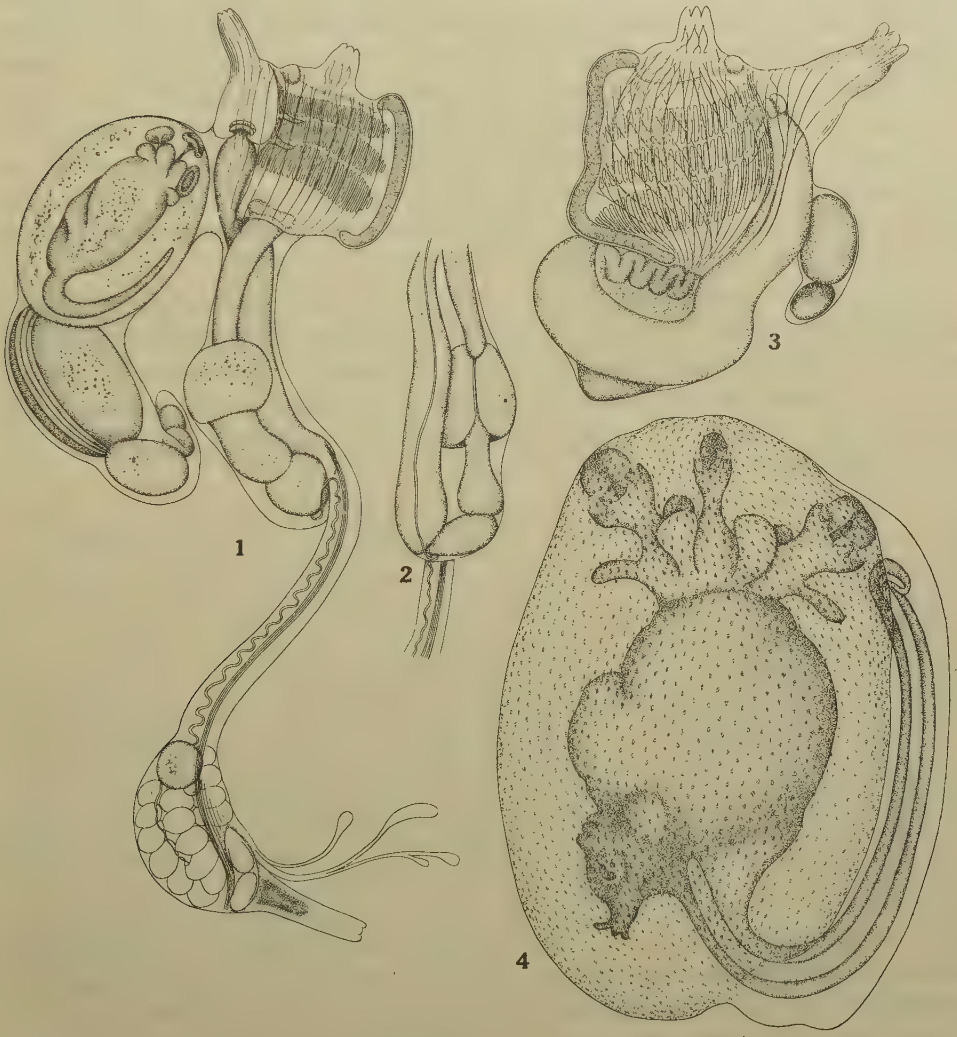


Fig. 3. *Pseudodistoma fragilis* n. sp.

1···Zooid, right side, enlarged; 2···Abdomen, left side, enlarged; 3···Zooid in a strongly contracted state, enlarged; 4···Embryo, ×35.

test perpendicularly or slightly obliquely at places where the colony is thick, but laid horizontally or strongly obliquely at some thin places. No system is found in the arrangement of zooids.

Thorax: The atrial siphon of a moderate length. There are about a dozen longitudinal muscles on each side of the thorax, a few dorsal ones of which are rather delicate; besides 7–8 delicate oblique muscles are running beneath the longitudinal musculature on the ventral half of the thorax (3 of the Figure). Stigmatal rows three, 25 to 30 stigmata in each row, horizontal membrane is well developed along the transverse vessels. Tentacles six, all very stout; the ciliated groove is an oval orifice, dorsal languets are displaced slightly to the left side from the dorso-median line. The anus is bilobed and opened at the level of the second transverse vessel.

Abdomen: The stomach is located near the middle of the abdomen and with the quite smooth surface. The hind-stomach and the mid-intestinal region are very distinct, the latter is laid horizontally at the posterior end of the abdomen or obliquely with its distal end at the posterior end of the abdomen. The proximal end of the rectum is swollen, but devoid of coeca.

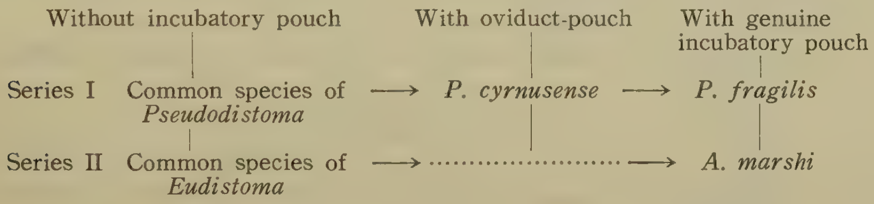
Postabdomen: The gonad is contained in the swollen part near the rear end of the postabdomen, where the ovary is situated just in front of the testis. Testicular follicles 21 to 39, being ca. 30 on an average. The heart is located at the distal end of the testis. A pair of longitudinal muscle bands are running along the whole length of the abdomen. One or two vascular appendages are issued from the cardiac area of the postabdomen; they are often ramified.

Larva: Larvae are very large and oval in outline. They are 2.3 mm to 2.6 mm in length of the trunk and width/length is 0.60 to 0.67. The tail is somewhat shorter than the trunk. The larval test is granulated. Three cup-shaped attachment processes are arranged linearly. There are two pairs of ampullae at the base of the attachment processes, besides the dorsal and ventral processes have each a finger-shaped process near the middle of the outer side of the peduncle. The sensory organ is located near the posterior end of the trunk, two pigment flecks are arranged dorso-ventrally.

Remarks: The present new species resembles most closely *Pseudodistoma cyrnusense* Pérès from Corsica in the Mediterranean Sea in the shape of the encrusting flat colony, the delicate consistency of the test, the general colouration of zooids and in the situation and number of testicular follicles. In *P. cyrnusense*, however, stigmata in each row are only 12 to 15 on one side and the oviduct plays the rôle of the incubatory chamber along the whole length, without forming any genuine incubatory pouch. Thus these two species can't be considered as being identical with each other. And for the present new species, the name *fragilis* is proposed from the delicate and extremely fragile character of the test.

Now it is evident that the present species belongs to the genus *Pseudodistoma* if the existence of the incubatory pouch is put out of the discussion, because the zooid has a very distinct postabdomen, three stigmatal rows, smoothly walled stomach and branchial and atrial apertures both opening directly to the exterior. Then, what is the relationship between the present form and the genus *Distaplia*? The existence of the incubatory pouch seems to be the sole characteristic common to these two. Some species of *Distaplia* have the gonad kept in an elongated protuberance from the abdomen as shown in *D. mikropnoa* (SLUITER), in such cases, however, the protuberance is issued from the left side of the intestinal loop and the heart is left on the right side of the intestinal loop, being never moved into the distal portion of the protuberance. The present form has only three stigmatal rows which are devoid of parastigmatic vessels, although the absence of parastigmatic vessels can't be accepted as one of the definite characteristics differentiating the present species from *Distaplia*, because *D. mikropnoa* (SLUITER) seems to be devoid of such vessels too. The existence of three stigmatal rows is, however, very unique. Moreover, there is no form in *Distaplia*, in which the atrial aperture opens directly to the exterior.

Then comes the turn to discuss on the incubatory pouch. The structure of the oviduct in *P. cyrnusense* PÉRÈS, which plays the rôle of the incubatory pouch, seems to show an intermediate state between the present new species with a distinct incubatory pouch and other species of *Pseudodistoma*, which are devoid of any incubatory pouch. There is another form which has an incubatory pouch, but does not belong to Holozoinae; this is *Atopozoa marshi* BREWIN known from Western Australia. The structure of the zooid of this compound ascidian is quite the same as that of *Eudistoma*, excepting for the existence of the incubatory pouch in the former.



All these forms conform one another in that they have three stigmatal rows without parastigmatic vessels, the atrial aperture opening directly to the exterior and the stomach smoothly walled. It is very interesting that the formation or the existence of the incubatory pouch is found in two groups of allied forms, the difference between these groups lies in the sole point that the postabdoman is formed in *Pseudodistoma*, while it is absent in *Eudistoma* and *Atopozoa*. The appearance of the postabdomen in *P. cyrnusense* and *P. fragilis* seems to show a rather primitive stage to the formation of the perfect postabdomen found in other species of *Pseudodistoma* and many species of other genera of Polyclinidae.

It might be possible to extend the definition of the subfamily Holozoinae to include *P. fragilis* and *A. marshi* which have three stigmatal rows without parastigmatal vessels and the atrial aperture opening directly to the exterior, here the difference between the postabdomen of *P. fragilis* and the genital protuberance in some species of *Distaplia* is put aside. Now the problem is to judge which is phylogenically more significant the existence of the incubatory pouch or the affinity between the forms in respective series (Series I and II). At present, it seems more reasonable to consider the latter as being phylogenically more important than the former.

Next comes the question, which is more significant phylogenically the formation of the incubatory pouch or that of the postabdomen. The existence of various degrees of development of the genital protuberance in species of *Distaplia* seems to support the possibility that *Pseudodistoma* and *Eudistoma*, including *Atopozoa* within the latter, are phylogenically related with each other so closely that they can't be placed respectively in different families Polyclinidae and Polycitoridae. Of course, more crucial examination on much more specimens are necessary to settle the present problem. Probably, in future, there might occur the same problems on some other genera in these families and also the necessity to reorganize these familes on more reasonable phylogenical relationship.

4. *Distaplia systematica* n. sp.

(Fig. 4)

One colony collected on April 11, 1952 from the coast of Hatakezima in the vicinity of the Seto Marine Biological Laboratory, Sirahama. It consists of six oval or round cormidia of which the largest one containing three systems is 9 mm in long diameter, while others are including each only a single system and less than 5 mm in diameter. The height of cormidia attains to 8 mm. These cormidia are connected with one another by broad and flat stolon-like basal extension of the test, which is creeping on the rock or the basal portion of some sea-weeds and wholly encrusted with detritus and faecal pellets ejected from the zooids. Each system consists of from 6 to 18 zooids surrounding a wide common cloacal aperture. The living specimen is coloured pinkish along the periphery of the cormidium and purplish brown at the centre; this colouration turns to simple greenish gray by preservation. The test is thin, very soft and transparent at the distal end of the cormidium, but rather opaque in other parts of the colony. Zooids are up to 2.1 mm in length in a fairly contracted state, of which 1.4 mm is occupied by abdomen. They are situated perpendicularly in the test, the thorax being in the distal part of the cormidium, swollen out of the common basal portion of the colony, while the abdomen being embedded in the basal portion. The margin of the common cloacal aperture is crenated.

Thorax: The branchial aperture 6-lobed. The atrial languet is considerably long and most frequently trifid at the tip. About twenty strongly developed transverse muscles on each side of the thorax, longitudinal muscles being quite obsolete. A pair of strong longitudinal muscles along the dorso-median line of the branchial sac. Stigmatal rows four. The anus is bilobed.

Abdomen: The surface of the stomach is usually smooth, rarely with a few faint striations. A vascular appendage is issued from the right side of the intestinal loop. Gonad immature in every examined zooid.

Remarks: The appearance of the colony and the thoracic musculature consisting of only transverse muscles are the characteristics of the present new species. Other locality: Simoda, Izu.

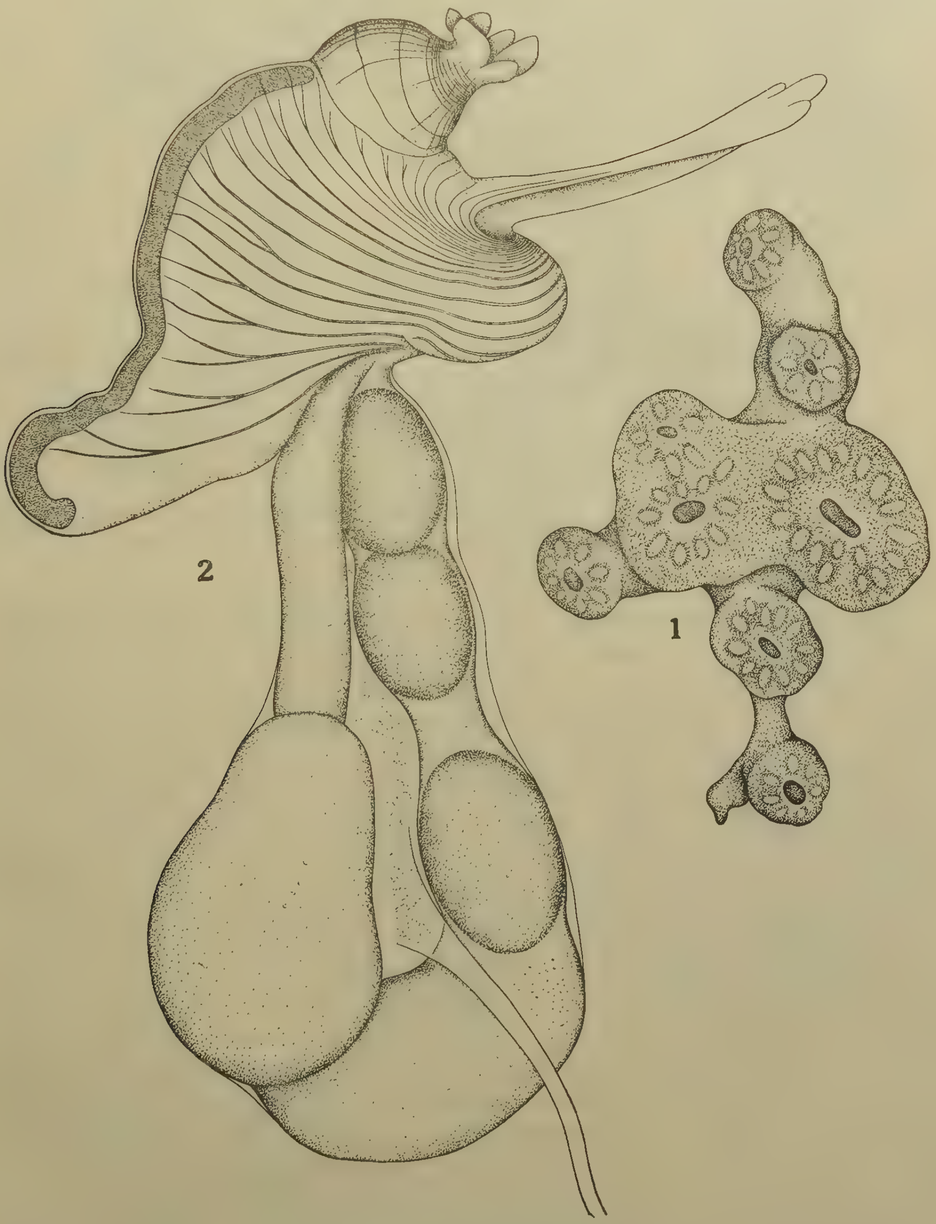


Fig. 4. *Distaplia systematica* n. sp.
1···Colony, enlarged; 2···Zooid, ×73.

5. *Polycarpa pedata* HERDMAN, 1881

(Figs. 5 and 6)

Polycarpa pedata—HERDMAN, W. A. (1881): Preliminary report on the Tunicata of the Challenger Expedition. Cynthiadae. Proc. Roy. Soc. Edinburgh, Vol. 11, p. 71.
HERDMAN (1882): Challenger Report, Vol. VI, Tunicata, p. 180, pl. 24 figs. 1–2.
TRAUSTEDT (1884): Vidensk. Meddel. Nat. For. Kjøbenhavn, ann. 1884, p. 48.
PIZON (1908): Rev. Suiss Zool., Vol. 16, p. 218.
HASTINGS (1931): Great Barrier Reef Exped., Sci. Rep. Vol. IV, No. 3, p. 74.
Styela whiteleggei HERDMAN (1899): Catalogue Australian Museum, Sydney. No. 17, pp. 40–41, Pl. Cyn. II figs. 6–7; Pl. Cyn. XIV figs. 1–6.
Pandocia pedata—VAN NAME (1918): U. S. Nat. Mus. Bull. 100, Vol. 1, Part 2, pp. 97–99, Text-fig. 49, Pl. 23 figs. 1–3.

Three specimens collected from the vicinity of the Seto Marine Biological Laboratory.

No. 1···55 mm long elongate individual carried on the back of a dromiid crab brought into the aquarium on April 24, 1952 (2 in Fig. 5).

No. 2···37 mm long elongate individual collected by Mr. T. YAMAMOTO on November 20, 1951 near the rocky islet "Sisôzima" in the vicinity. Attached to the substratum by the ventral side (1 in Fig. 5).

No. 3···80 mm high, 49 mm wide dorso-ventrally and 42 mm laterally; attached to the substratum by the left-ventral side (1 in Fig. 6). Details of the date and habitat unknown.

In two of the three specimens (Nos. 1 and 2), both apertures are nearly sessile; the branchial aperture is terminal and the atrial aperture is situated near the posterior end of the body widely apart from the branchial, while in the other specimen, both apertures are opened each on a short siphon, the branchial siphon is terminal and the atrial is situated near the branchial, although the base of the atrial siphon is located far posteriorly. The apertures are surrounded in two smaller specimen by lobules up to a dozen in number. The test is leathery, hard and strong and attains to 8–9 mm in thickness at some parts of the basal portion. The surface is smooth, but with a few irregularly formed grooves and quite free from foreign matters in two smaller specimens, but partly covered by some hydrozoans and algae in the largest individual. The living specimen is pretty orange in colour, sometimes sprinkled with reddish spots (Nos. 1 and 2) or grayish white to pinkish gray (No. 3). The colour fades to yellowish gray in formalin. The inner surface of the test is not glistening. All specimens are devoid of the pedal extension of the test. The mantle is dark purplish brown or dark brownish, the viscera are also pigmented in the same colouration. The mantle is considerably thick, attaining to 2 mm at some thick portions. The branchial aperture is terminal and the atrial siphon is situated near the middle of the body. There are many endocarps on the inner surface of the mantle (3 and 4 in Fig. 5). Atrial velum well developed and with small tentacles.

Branchial sac: Inner longitudinal vessels are arranged as:

55 mm long individual.

Left D. 20 (39) 7 (38) 12 (39) 10 (32) 3 (5) ? V.
Right D. 18 (28) 10 (35) 13 (37) 13 (38) 12 V.

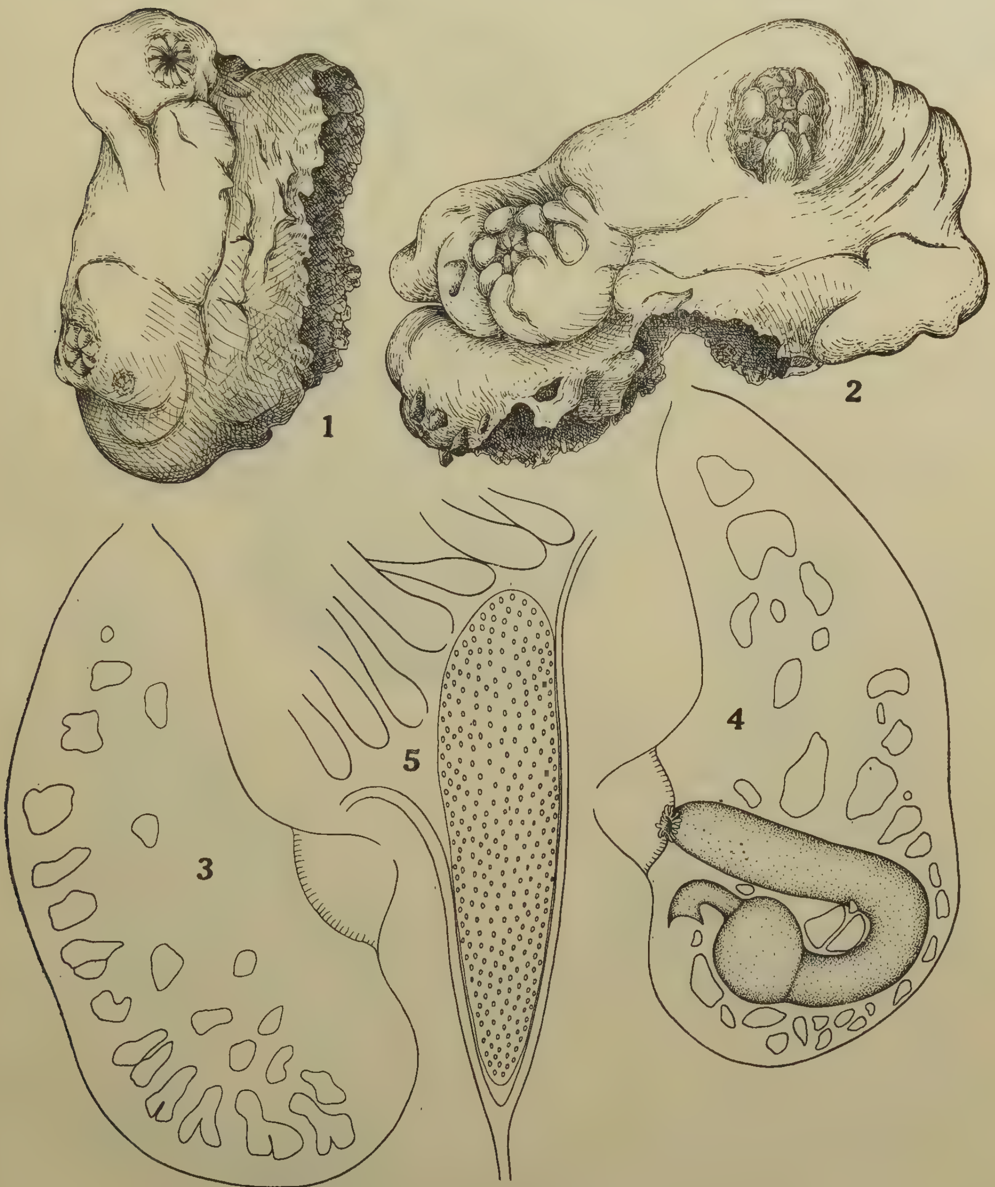


Fig. 5. *Polycarpa pedata* HERDMAN.

1…37 mm long specimen, 2…55 mm long specimen, 3…Right half of mantle body of the same specimen, from inside; 4…Left half of mantle body of the same specimen, from inside; 5…Dorsal tubercle of the same specimen, enlarged.

80 mm long individual.
Left D. 18 (33) 8 (34) 9 (27) 10 (23) 10 V.
Right D. 15 (27) 9 (37) 8 (35) 8 (35) 9 V.

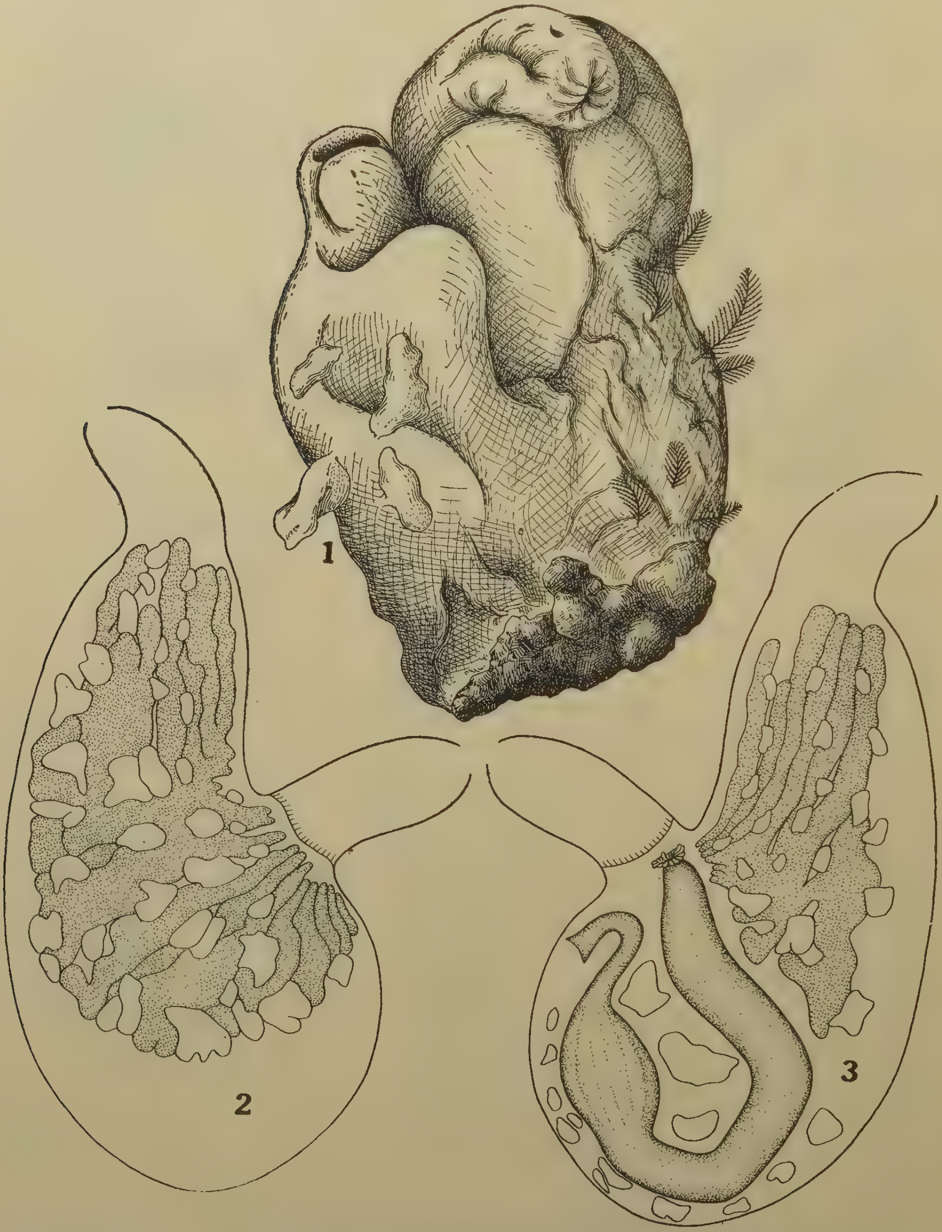


Fig. 6. *Polycarpa pedata* Herdman.
1…80 mm long specimen, 2…Right half of mantle body, from inside; 3…Left half of mantle body, from inside.

A rudimentary fifth fold was observed in the posterior part of the left side in the 55 mm long individual. Seven to fifteen thinner transverse vessels are found between each pair of thicker ones, parastigmatic vessels practically absent. From three to six small stigmata in each mesh. Tentacles 23 to 34, larger and smaller ones are differentiated. The dorsal tubercle is very large and elongate, about 3 mm long in the 55 mm long individual (5 in Fig. 5); the ciliated grooves consist of numerous orifices, 180 in the 80 mm long specimen and 300 or thereabout in the 37 mm and 55 mm long individuals.

Alimentary system: The alimentary canal figures a very simple loop, without forming the second intestinal loop. Three endocarps are found in the intestinal loop. The stomach round or oval in outline; the surface is quite smooth, although several longitudinal plications of the inner wall are seen through; pyloric coecum absent. The anus is fringed with 15–17 lobules.

Gonad: The gonad was found only in the 80 mm long individual (2 and 3 in Fig. 6). The gonads are considered as being originally of elongate form, but actually many of them are anastomosing complicatedly and form an irregularly shaped genital mass on each side. On the present specimen, seven genital ducts are found on the left side and 14 ones on the right side. The existence of some elongate genital sacs seems to show the close relationship between the present species and the genus *Cnemidocarpa*.

Remarks: A kind of pontinid shrimp was found in the branchial sac in all of the three specimens.

LITERATURE CITED

BREWIN, B. I. (1956): *Atopozoa marshi*, a compound ascidian from Western Australia. Jour. Roy. Soc. Western Australia, Vol. 40, pp. 31–32, Figs. A–G.

HASTINGS, A. B. (1931): Tunicata in: Great Barrier Reef Expedition. Scientific Report, Vol. IV, No. 3, pp. 69–110, Pls. I–III, 17 text-figs.

MICHAELSEN, W. (1930): Ascidiae Krikobranchiae in: Die Fauna Südwest Australiens. Bd. V, Lief. 7, pp. 463–558, 12 text-figs.

PÉRÈS, J. M. (1952): Ascidies de la roche littorale Corse. Recueil des Travaux de la Station Marine d'Endoume, Fasc. 6, pp. 35–44, Pl. IV.

RITTER, W. E. and FORSYTH, R. A. (1917): Ascidians of the littoral zone of South California. Univ. California Publ. Zool., Vol. 16, No. 24, pp. 439–512, Pls. 38–46.

TOKIOKA, T. (1954): Invertebrate Fauna of the intertidal zone of the Tokara Islands. VII. Ascidians. Publ. Seto Mar. Biol. Lab., Vol. III, No. 3, pp. 239–264, Pls. XVIII–XXXVII, 2 text-figs.

TOKIOKA, T. (1955): Ascidians from the Palao Islands. II. Ibid., Vol. V. No. 1, pp. 43–57, Pls. I–VI, 4 text-figs.

VAN NAME, W. G. (1902): The ascidians of the Bermuda Island. Trans. Connecticut Acad. Sci., Vol. 11, pp. 325–412, Pls. XLVI–LXIV.

VAN NAME, W. G. (1918): Ascidians from the Philippine and adjacent waters. U. S. Nat. Mus. Bull. 100, Vol. 1, Part 2, pp. 49–111, 115 text-figs., Pls. 23–33.

VAN NAME, W. G. (1945): The North and South American ascidians. Bull. American Mus. Nat. Hist., Vol. 84, 476 pp., 31 pls., 327 text-figs.

THE PELAGIC COPEPODS OF THE IZU REGION, MIDDLE JAPAN
SYSTEMATIC ACCOUNT, V

FAMILY EUCHAETIDAE

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With 19 Text-figures

Family EUCHAETIDAE

Genus *Euchaeta* Phillipi, 1843

The genus *Euchaeta* was separated by A. Scott in two: *Euchaeta* and *Pareuchaeta.* The chief differences between the two genera are in the armature of the spines on the apex of the 2nd maxilla of the female and in the structure of the male 5th pair of legs. In Phillipi's type the 5th pair of legs are decidedly different from those found in *Euchaeta norvegica* Boeck; in *Euchaeta* in restricted sense two of the six apical spines of the 2nd maxilla, in addition to being furnished with rows of very fine short spinules, have also a number of moderately long and conspicuous spinules in the female; the male is characterised by the posession of long spiniform terminal joint on both sides of the 5th pair of legs.

Sewell (1947) divided *Euchaeta* (sensu stricto) into two groups: Group I, of which *Euchaeta marina* (Prestand.) may be taken as the type; in the female of the group two of the apical spines arising from the terminal portion are armed with long spinules; to this group may be referred *E. marina* and *E. wolfendeni* A. Scott. In Group II only a single spine arising from the endopod of the 2nd maxilla is furnished with lateral spinules; in this group the following species are included: *E. acuta* Giesbrecht, *E. concinna* Giesbrecht, *E. consimilis* Farran, *E. media* Giesbrecht, *E. spinosa* Giesbrecht, *E. tenuis* Esterly and *E. mrrrayi* Sewell.

Following 6 species have been reported from the Japanese waters by Mori: *E. marina* (Prestand.), *E. wolfendeni* A. Scott, *E. longicornis* Giesbrecht, *E. concinna* Dana, *E. plana* Mori, and *E. media* Giesbrecht. Two more species *E. pubera* Sars and *E. spinosa* Giesbrecht were added to the list of the Japanese species.

Publl. Seto Mar. Biol. Lab., VI (3), 1958. (Article 18)

Euchaeta marina PRESTANDREA

Euchaeta marina GIESBRECHT, 1892, p. 245 ; A. SCOTT, 1909, p. 67 ; WOLFENDEN, 1911, p. 299 ; SEWELL, 1912, p. 360 ; G. O. SARS, 1925, p. 104 ; FARRAN, 1929, p. 237 ; SEWELL, 1929, p. 148 ; WILSON, 1932, p. 63 ; MORI, 1937, p. 43 ; SEWELL, 1947 ; p. 113 ; WILSON, 1950, p. 214 ; BRODSKY, 1950, p. 197.

Length. Female, 3.10–3.26 mm ; *male,* 3.50–3.64 mm.

Remarks. The present female specimen belongs to the small-sized example which has been suggested by SEWELL (1947).

Occurrence. Very common in the surface layer.

Distribution. The species has a wide distribution in the Pacific, Indian and Atlantic Oceans.

Euchaeta wolfendeni A. SCOTT

Euchaeta wolfendeni A. SCOTT, 1909, p. 68, pl. 17 ; SEWELL, 1914, p. 216 ; SEWELL, 1929, p. 153 ; FARRAN, 1936, p. 91 ; MORI, 1937, p. 44 ; SEWELL, 1947, p. 115 ; WILSON, 1950, p. 217.

Length. Female, 2.45–2.70 mm ; *male,* 2.45 mm.

Occurrence. Fairly common in the surface layer.

Distribution. The species has been recorded from the Malay Archipelago, Maldive Archipelago and the Indian Ocean. It is also distributed in the warm waters of Japan.

Euchaeta longicornis GIESBRECHT

Euchaeta longicornis GIESBRECHT, 1892, p. 246 ; A. SCOTT, 1909, p. 66 ; FARRAN, 1929, p. 238 ; FARRAN, 1936, p. 89 ; MORI, 1937, p. 45 ; WILSON, 1950, p. 212.

Length. Female, 2.56–3.00 mm ; *male,* 3.00 mm.

Occurrence. It is common in the surface layer.

Distribution. It is widely distributed in the temperate and warm waters of the Pacific and Indian Oceans. It has been recorded from the warm waters in Japan.

Euchaeta concinna DANA

Euchaeta concinna GIESBRECHT, 1892, p. 246 ; A. SCOTT, 1909, p. 65 ; WOLFENDEN, 1911, p. 299 ; SEWELL, 1929, p. 146 ; FARRAN, 1936, p. 90 ; MORI, 1937, p. 45, pl. 20 ; WILSON, 1950, p. 212.

Length. Female, 2.87–3.25 mm ; *male,* 2.59–2.80 mm.

Occurrence. It is common in the surface layer.

Distribution. It has been recorded from the Indian and Pacific Oceans.

Euchaeta plana MORI

(Fig. 62, *a–g*)

Euchaeta plana MORI, 1937, p. 46, pl. 21, figs. 1–8.

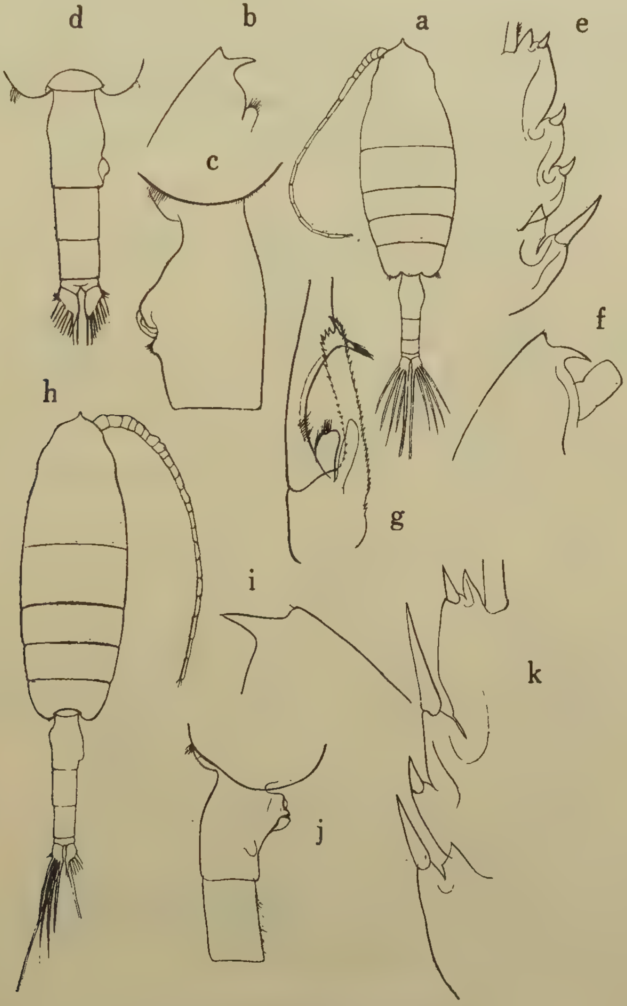

Fig. 62. *Euchaeta plana* MORI (*a–g*).
Female: *a*, dorsal aspect; *b*, head, lateral aspect; *c*, last thoracic segment and genital segment, lateral aspect; *d*, last thoracic segment and abdomen, dorsal aspect; *e*, exopodite of 2nd leg. Male: *f*, head, lateral aspect; *g*, 2nd joint of exopodite of left 5th leg.
Euchaeta media GIESBRECHT (*h–k*).
Female: *h*, dorsal aspect; *i*, head, lateral aspect; *j*, last thoracic segment and abdominal segments, lateral aspect; *k*, exopodite of 2nd leg.

Female. Length, 2.87–3.38 mm. The abdomen is contained about 2.3 times in the length of the cephalothorax. The lateral corner of the last thoracic segment evenly rounded. The frontal prominence high. The rostrum curved downwards.

The proportional lengths of the four free abdominal segments and furca are 44 : 23 : 17 : 3 : 13 = 100. The genital segment slightly asymmetrical: the right side is more inflated. Some specimens have on the distal right corner of the genital segment a conical chitinous attachment which can be easily removed. The 2nd and 3rd segments are furnished densely with fine short hairs. The furcal setae are of about equal lengths. The appendicular seta long and strong.

The 1st antenna extends about to the middle of the genital segment. The 1st outer lobe of the 1st maxilla has 5 setae.

In the 1st leg the outer margin of the joints 1–2 of the exopodite is straight. The 2nd leg has on the 2nd joint of the exopodite a moderately long outer edge spine extending to the base of the proximal spine of the 3rd joint of the exopodite; the 2nd outer marginal spine of the 3rd joint is short.

Male. Length, 2.75–2.95 mm. The male has the similar structure in the 5th pair of legs as those of *E. concinna*; the process on the 2nd joint of the exopodite of the left leg is more coarsely denticulated.

Occurrence. It is common in the surface layer.

Distribution. The species is distributed in the temperate waters of Japan.

Euchaeta media GIESBRECHT

(Fig. 62, *h–k*)

Euchaeta media GIESBRECHT, 1892, p. 246; ESTERLY, 1905, p. 160; A. SCOTT, 1909, p. 66; FARRAN, 1929, p. 238; SEWELL, 1929, p. 149; FARRAN, 1936, p. 89; MORI, 1937, p. 46; pl. 18; SEWELL, 1947, p. 116; WILSON, 1950, p. 214; BRODSKY, 1950, p. 200, fig. 116; VERVOORT, 1957, p. 84.

Female. Length, 40.0–4.32 mm; *male*, length, 3.63 mm.

Remarks. The male specimen is synonymous with the male of *E. acuta* var. *pacifica* described by ESTERLY.

Occurrence. The species is rather rare in the Izu region.

Distribution. The species has a wide distribution in the temperate and warm waters of the Pacific, Indian and Atlantic Oceans.

Euchaeta pubera G. O. SARS

(Fig. 63, *a–e*)

Euchaeta pubera SARS, 1925, p. 109, pl. 30; FARRAN, 1929, p. 238: WILSON, 1950, p. 215.

Female. Length, 3.75 mm: cephalothorax, 2.80 mm; abdomen, 0.95 mm. The body is covered with short hairs. The lateral corner of the last thoracic segment evenly rounded. The rostrum rather slender, directs straight forwards.

The abdomen is contained 3 times in the length of the cephalothorax. The proportional lengths of the four free segments and furca are 43 : 17 : 17 : 4 : 19 = 100. The genital segment has a lateral swelling on each side about the proximal 1/3 of the segment; the ventral surface has claw-like process on the genital protuberance. The 2nd and 3rd segments are very setose. The appendicular seta very long, at least, 7 times as long as the other marginal setae which are of about the same lengths.

The 1st antenna extends to the end of the last thoracic segment.

The outer edge spine of the 2nd joint of the exopodite of the 2nd leg reaches the middle of the proximal spine of the 3rd joint.

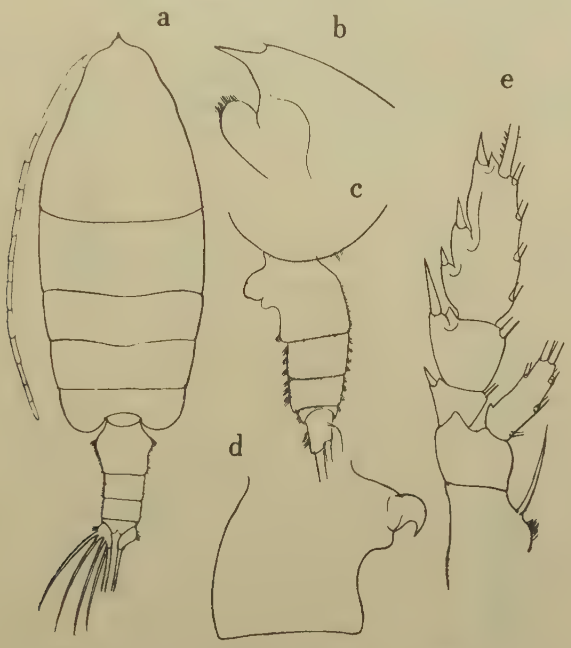

Fig. 63. *Euchaeta pubera* G. O. SARS.
Female: *a*, dorsal aspect; *b*, head, lateral aspect; *c*, last thoracic segment and abdomen, lateral aspect; *d*, genital segment, lateral aspect; *e*, 2nd leg.

Remarks. SARS in his "Copepoda bathypelagique" says that *E. pubera* is identical with *E. wolfendeni* A. SCOTT. But the latter is a quite different species, and has been collected from the surface layer of the tropical and subtropical regions of the Pacific, Indian and Malay Archipelago, whereas, the former is deep sea species.

Occurrence. Only a single female was collected in the vertical haul 1000–0 m, July 1936 in Suruga Bay.

Distribution. It has been recorded from the deep waters of the Atlantic.

Euchaeta spinosa GIESBRECHT

(Fig. 64, *a–e*)

Euchaeta spinosa GIESBRECHT, 1892, p. 246; ESTERLY, 1905, p. 159; SARS, 1925, p. 104; FARRAN, 1929, p. 256; SEWELL, 1929, p. 149; SEWELL, 1949, p. 117; WILSON, 1950, p. 217; BRODSKY, 1950, p. 200.

Female. Length, 7.20 mm: cephalothorax, 5.20 mm; abdomen, 2.00 mm. The cephalothorax elongate ovate. The lateral corner of the last thoracic segment rounded, and is furnished with tufts of hairs and scattered short hairs. The rostrum slender, directs straight and slightly downwards. The frontal prominence high.

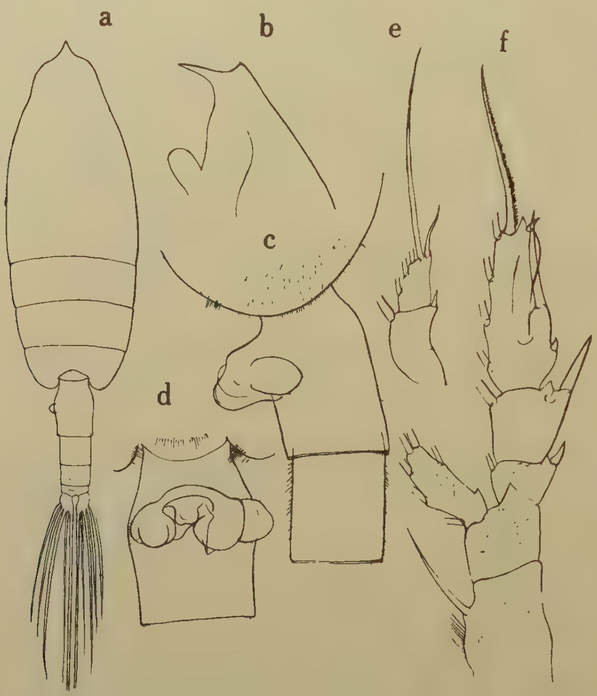

Fig. 64. *Euchaeta spinosa* GIESBRECHT.
Female: *a*, dorsal aspect; *b*, head, lateral aspect; *c*, last thoracic segment and abdominal segments, lateral aspect; *d*, genital segment, ventral aspect; *e*, exopodite of 1st leg; *f*, 2nd leg.

The abdomen is contained 3.6 times in the length of the cephalothorax; the segments and furca in the proportional lengths 42 : 23 : 16 : 8 : 11 = 100. The genital segment slightly asymmetrical: the lateral margin produced on the middle of the left side; the genital protuberance also asymmetrical; there is a rounded prominence arising from the genital boss on the left side; the lateral flanges asymmetrical, that of the left side is conspicuous. The furcal rami about as long as wide. The appendicular seta very long, about 5 times as long as the abdomen.

The 1st antenna extends to the middle of the distal margin of the 3rd abdominal segment; the joints 3, 7, 9 and 14 have each a long seta. The mouth parts as described by GIESBRECHT.

The 1st leg has 2-jointed exopodite; the line of fusion detectable. The 2nd leg has 3-jointed exopodite and 1-jointed endopodite; the outer edge spine of the 2nd joint of the exopodite exceeds the distal margin of the 1st outer marginal spine of the 3rd joint; the 2nd outer marginal spine of the 3rd joint of the exopodite exceeds the distal margin of the joint; the basal joints, the 1st joint of the exopodite and endopodite are furnished with groups of minute spines on the posterior surface; the endopodite of the same leg is covered with spinules also on the anterior surface. The 3rd leg has 3-jointed exopodite and endopodite; the basal joints, the exopodite and endopodite are furnished with fine spinules both on the posterior and anterior surfaces. The 4th leg has 3-jointed exopodite and endopodite, and has the same structure as in the 3rd leg.

Occurrence. Only a single female from Suruga Bay from the depth 1000–0 m, March 1938.

Distribution. The species has been recorded from the Mediterranean Sea and Indian Ocean, also from the San Diego region, Azores and Canary.

Genus *Pareuchaeta* A. SCOTT, 1909

The genus was created by A. SCOTT to accomodate a number of species that differ from the PHILLIPI's type in the armature of the apical setae of the 2nd maxilla, and by the structure of of the male 5th pair of legs. According to G. O. SARS the appendicular seta of the female is long and thickened in *Euchaeta*, whereas, it is slender in *Pareuchaeta*. FARRAN called attention to the fact that in *Euchaeta hebes* T. SCOTT and *E. russelli* FARRAN the innermost seta of the 6th lobe of the 2nd maxilla has long and widely separated spinules, and, further, the appendicular seta of the furca is thickened and prolonged in the female; the 3rd joint of the male left 5th leg is not prolonged into a point; these two species appear to be intermediate form between *Euchaeta* and *Pareuchaeta*. SARS, however, included *E. hebes* in the genus *Euchaeta*.

SEWELL (1947) divided *Pareuchaeta* into 4 groups according to the number of setae arising from the outer lobe of the 1st maxilla: Group I. Le 1 of the 1st maxilla of the female bears in all 9 setae, of which 6 are stout, and the 2 proximal and the distal setae are considerably smaller; to this group belong *P. hanseni* (WITH), and *P. weberi* A. SCOTT. Group II. Le 1 of the 1st maxilla of the female bears 7 setae, of which the 2 proximal are usually small; to this group belong *P. barbata* (BRADY), *P. californica* (ESTERLY), *P. scotti* (FARRAN). Group III. Le 1 of the 1st maxilla of the female bears 6 setae; to this group belong *P. bisinuata* SARS. Group IV. Le 1 of the 1st maxilla of the female bears 5 setae; to this group belong *P. scotti* (WOLFENDEN) and *P. russelli* (FARRAN).

VERVOORT (1957) is of opinion that separation of the genera *Euchaeta* and *Pareuchaeta* is unjustified. He, accordingly, divided the genus *Euchaeta* into 5 groups according to the characters of the apical setae of the 2nd maxilla in the female and the vestigial 3rd left exopodal joint of the 5th pair of legs in the male: 1. *E. marina* group; 2. *E. flava* group; *E. hebes* group; 4. *E. pubera* group; 5. *E. norvegica* group. To the last group belong the species of the genus *Pareuchaeta*.

Most of the species belonging to *Pareuchaeta* have a minute outer edge spine at the bottom of the concavity where the 1st and 2nd joints of the exopodite of the 1st leg are fused, whereas, this spine is absent in *Euchaeta*. In *Pareuchaeta* the outer edge spine of the 2nd exopodal joint of the female 2nd leg shows different proportional lengths in accordance with the species involved. We can divide the length into three groups: 1. the spine exceeds beyond the end of the proximal outer marginal spine of the 3rd joint; to this group belong *P. californica* (ESTERLY) and *P. sibogae* A. SCOTT; 2. the spine reaches about to the end of the proximal outer marginal spine of the 3rd joint; to this group belong *P. barbata* (BRADY), *P. malayensis* SEWELL, *P. bisinuata* SARS, *P. weberi* A. SCOTT, *P. confusa* sp. nov., *P. calva* sp. nov., *P. aequatorialis* nom. nov.; 3. the spine exceeds beyond the base but not reaches the end of the proximal outer marginal spine; to this group belong *P. sarsi* (FARRAN), *P. hanseni* (WITH), *P. comosa* sp. nov., *P. propinqua* (ESTERLY) and *P. tonsa* (GIESBRECHT).

Three species of this genus have been reported by MORI from the Japanese waters: *E. flava* GIESBRECHT, *E. japonica* MARUKAWA and *E. daitomarui* MORI: the first species appears to be not identical with *E. flava* GIESBRECHT; the second species is synonymous with *E. elongata* ESTERLY; the third species is clearly the the synonym of *E. russelli* FARRAN. SEWELL (1929) recorded the following eight species from the Indian Seas: *P. barbata* (BRADY), *P. bisinnata* SARS, *P. californica* (ESTERLY), *P. investigatoris* SEWELL, *P. gracilicauda* A. SCOTT, *P. malayensis* SEWELL, *P. tuberculata* A. SCOTT, and *P. weberi* A. SCOTT. I have detected in the collection 16 species, of which three appear to be new to science. WOLFENDEN (1911) described a form under the name *E. scotti* but his specimen differs from FARRAN's original type of *scotti* in certain particulars. I have, therefore, given to the WOLFENDEN's form a new name *P. aequatorialis*.

Pareuchaeta russelli (FARRAN)

(Fig. 65, *a–g*)

Euchaeta russelli FARRAN, 1936, p. 91, fig. 7, a–i; *Euchaeta daitomarui* MORI, 1937, p. 48, pl. 23, figs. 4–8.

Female. Length, 3.14–4.06 mm. The abdomen is contained 2.6–times in the length of the cephalothorax. The lateral corner of the last thoracic segment rounded, with three tufts of hairs; the one on the dorsal, and the other two on the ventral margins. The rostrum directs forwards and slightly downwards. The frontal prominence low.

The proportional lengths of the first three abdominal segments are 23 : 13 : 12. The genital protuberance slightly projecting; the genital aperture is enclosed by a pair of curved lateral flanges; that on the left side is more prominent than that on the right; the genital segment has tufts of hairs on the distal margin of the ventral surface; there is a faint transverse dorso-lateral ridge to the left of the middle line at the anterior one-third of the genital segment. The first three segments are covered with fine short hairs. The furca very setose; the 2nd furcal seta about 2 times, and the appendicular seta about 3 times as long as the remaining marginal ones.

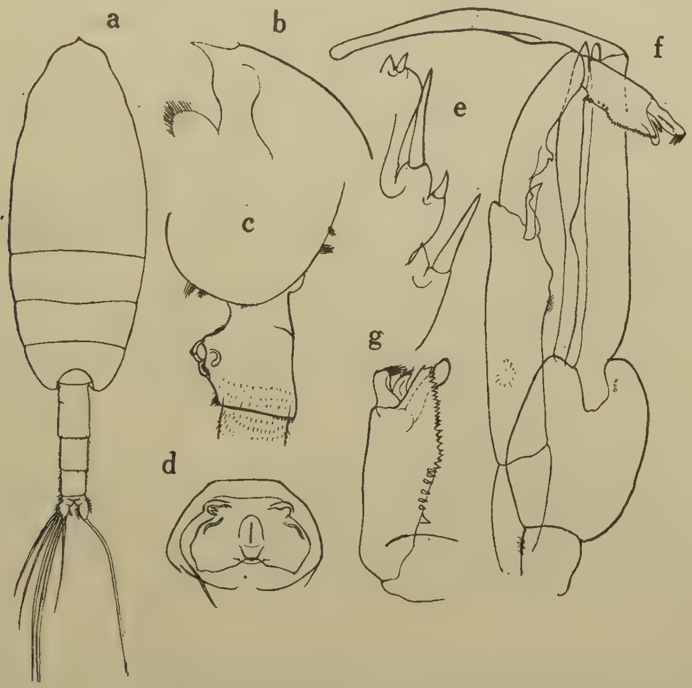

Fig. 65. *Pareuchaeta russelli* (Farran).
Female: *a*, dorsal aspect; *b*, head, lateral aspect; *c*, last thoracic segment and genital segment, lateral aspect; *d*, genital opening, ventral aspect; *e*, exopodite of 2nd leg. Male: *f*, 5th pair of legs; *g*, terminal joints of left 5th leg.

The 1st antenna reaches the posterior corner of the last thoracic segment; the lengths of the distal joints in 0.01 mm are as follows:

Joint	15	16	17	18	19	20	21	22	23	24–25
	13.4	16	16	17.9	20.5	21.5	19.2	16	16	21.5 ;

the 17th joint is shorter than the 21st, the 19th is about as long as the 24–25th. The

1st maxilla has 5 long setae on the 1st outer lobe. In the 2nd maxilla one of the apical setae is furnished, in addition being furnished with rows of short spinules, with long widely separated spinules; this is a generic character of the genus *Euchaeta* (sensu stricto).

The exopodite of the 1st leg has a small outer edge spine at the bottom of the concavity where the 1st and 2nd joints are fused. In the exopodite of the 2nd leg the outer edge spine of the 2nd joint exceeds the middle of the proximal spine of the 3rd joint; the 2nd outer marginal spine of the 3rd joint reaches the distal margin of the joint.

Male. Length, 3.10–3.45 mm. The abdomen is contained 2.42 times in the length of the cephalothorax. The lateral corner of the last thoracic segment rounded. The rostrum more slender than that of the female, and directs downwards.

The genital segment has a small dorsal process near the anterior border when viewed in lateral aspect. The 2nd, 3rd and 4th segments are fringed with coarse teeth on the postrior margin. The 2nd furcal seta about 2-times, the appendicular seta as long as the remaining marginal ones.

The 1st antenna extends beyond the end of the last thoracic segment by distal one joint; no aesthetask on the 20th joint; the articular membrane between the joints 12 and 13 distinct across to the posterior margin.

The mouth parts and the 1st to 4th legs have no interesting features.

In the left 5th leg the middle process of the distal joint of the exopodite is shorter than the tooth-plate of the 2nd joint; the 3rd joint of the exopodite short; the 1st joint of the exopodite of the left leg has a triangular process on the inner margin about the proximal 1/3 of the joint.

Remarks. The present species occupies, as stated by FARRAN, a similar position to *Euchaeta hebes* GIESBRECHT, in having the characters of *Euchaeta* in the female, and that of *Pareuchaeta* in the male. *Euchaeta daitomarui* described by MORI from the Japanese waters is identical with the present species.

Occurrence. The species is very comnon in the surface and intermediate layers of the Izu region.

Distribution. The species has been recorded from the Great Barrier Reef region. It is widely distributed in the warm waters of the North and South Pacific.

Pareuchaeta simplex sp. nov.

(Fig. 66, *a–h*)

Euchaeta fiava MORI, 1937, p. 47, pl. 21, 22.

Female. Length, 3.15–3.45 mm. General appearance as in *P. russelli.* The abdomen is contained 2.5 times in the length of the cephalothorax. The posterior margin of the last thoracic segment rounded, and has two tufts of hairs, one on the dorsal and the another on the posterior corner; the postero-dorsal margin, between these tufts of hairs, is furnished with short hairs when viewed from the lateral. The rostrum curved somewhat downwards. The frontal prominence low.

The first three abdominal segments have the following proportional lengths measured in 0.01 mm: 41 : 22 : 20. The genital protuberance not deep; the lateral flanges of the genital pore symmetrical; the inner chitinous process rounded in lateral aspect; the genital segment contracts laterally at the proximal one-fourth of the segment when viewed from the dorsal; the 2nd and 3rd segments are covered with fine hairs. The furcal rami as in *P. russelli*.

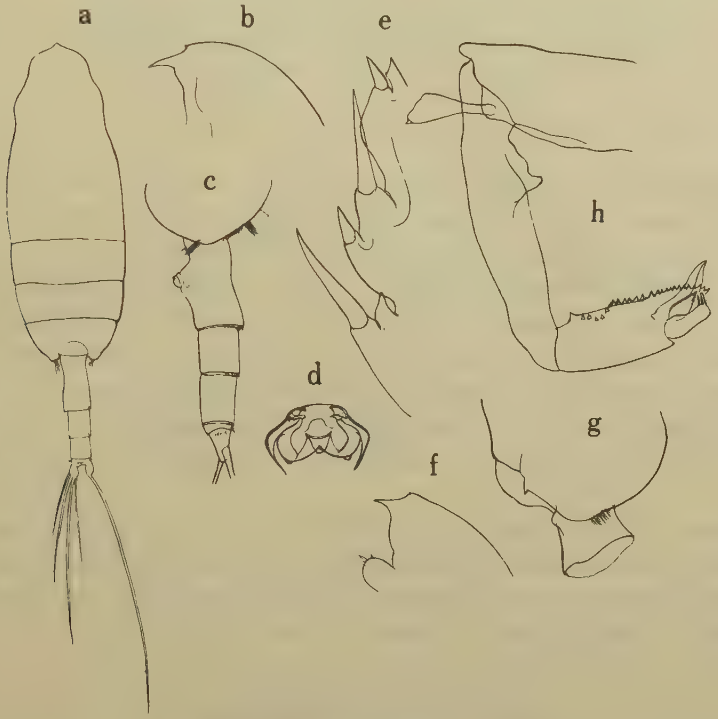

Fig. 66. *Pareuchaeta simplex* sp. nov.
Female: *a*, dorsal aspect; *b*, head, lateral aspect; *c*, last thoracic segment and abdomen, lateral aspect; *d*, genital opening, ventral aspect; *e*, exopodite of 2nd leg. Male: *f*, head, lateral aspect; *g*, last thoracic segment and genital segment, lateral aspect; *h*, 1st and 2nd joints of exopodite of left 5th leg.

The 1st antenna exceeds the posterior margin of the last thoracic segment by distal 2 joints; the lengths of the joints being in the following lengths in 0.01 mm:

Joint	1	2	3	4	5	6	7	8–9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24–25
	9.2	7.3	5.5	6.4	5.5	7.8	7.3	10.1	7.3	7.3	9.2	11.9	11.0	13.8	14.7	15.6	16.3	19.2	19.2	18.4	16.5	15.6	20.0;

the joints 24–25 are 1.14 times as long as the 19th, whereas, it is only 1.04 times in *P. russelli*.

Male. Length, 2.77–2.88 mm. The specimen resembles quite well with the male of the preceding species. Abdomen is contained 2.4–2.5 times in the length of the cephalothorax. Rostrum slender, directs downwards. The proportional lengths of the first 4 abdominal segments in 0.01 mm are 17.9, 17.9, and 12.5.

The 1st antenna as that of the preceding species; the joints are in the following lengths measured in 0.01 mm:

Joint	1	2	3	4	5	6	7	8–9	10	11	12	13	14
	11.0	7.3	4.6	6.9	6.4	6.9	7.3	16.5		6.4	9.2	9.2	9.2

15	16	17	18	19	20	21	22	23	24–25
10.1	11.9	11.9	12.8	15.6	15.6	15.0	14.7	13.7	19.3.

The mouth parts and swimming legs are as in *P. russelli*. The 5th pair of legs as those of *P. russelli*, but the 3rd finger of the terminal joint of the left leg is tapered.

Remarks. The specimen is closely related to *E. russelli*, and also to *E. flava* GIESBRECHT. MORI described and figured a species under the name *E. flava* from the Japanese waters. GIESBRECHT's *flava* has the genital protuberance produced ventrally when viewed from the lateral aspect, whereas MORI's, *flava* and the present specimen have the genital protuberance not so produced ventrally. MORI's *flava* appears to be identical with the present species. GIESBRECHT's description and figures of *E. flava* are not given enough in details for the identification of so closely allied species.

Occurrence. The specimens were collected in small numbers mixed with *P. russelli* from the surface and intermediate layers. GIESBRECHT's *flava* was collected from the South Pacific. FARRAN (1929, 1936), WOLFENDEN (1911) and WILSON (1950) failed to detect *E. flava* GIESBRECHT from the South Pacific.

Pareuchaeta barbata (BRADY)

(Fig. 67, *a–e*)

Euchaeta barbata, FARRAN, 1908, p. 40; WITH, 1915, p. 174; *Pareuchaeta barbata*, SARS, 1925, p. 112; JESPERSEN, 1934, p. 78, WILSON, 1950, p. 276; BRODSKY, 1950, p. 209; VERVOORT, 1957, p. 83.

The incomplete description and figures of *Euchaeta barbata* first given by BRADY have caused confusion in the determination of the species, and many authors have attempted to identify *Euchaeta barbata* BRADY. Up to the present several distinct species have been reported as *Euchaeta barbata*. It is generally accepted that the form described by FARRAN (1908) under the name *E. barbata* is the same species that had been described by BRADY. SEWELL (1929) described a form that differed from FARRAN's specimen. SEWELL says that his specimen taken from the Indian waters is the nearest to the BRADY's type though smaller in size than those found in the other waters. SEWELL's specimen differs from that described by FARRAN in the following: small in size, the shape of the lateral corners of the last thoracic segment, the absence of the tubercle on the left lateral margin of the genital segment, the proportional lengths of the 1st antenna, the number of the setae on the outer lobe of the 1st maxilla, and the length of the proximal spine on the 3rd joint of the exopodite of the 2nd leg. I have detected two specimens which are quite identical with the form described by FARRAN though much smaller in size.

Female. Length, 6.17 mm: cephalothorax, 4.76 mm; abdomen, 1.94 mm. The abdomen is contained about 2.5-times in the length of the cephalothorax. The lateral margin of the last thoracic segment rounded and slightly contracted at the postero-ventral corner, and carries a tuft of hairs. The frontal prominence low. The rostrum directs downwards.

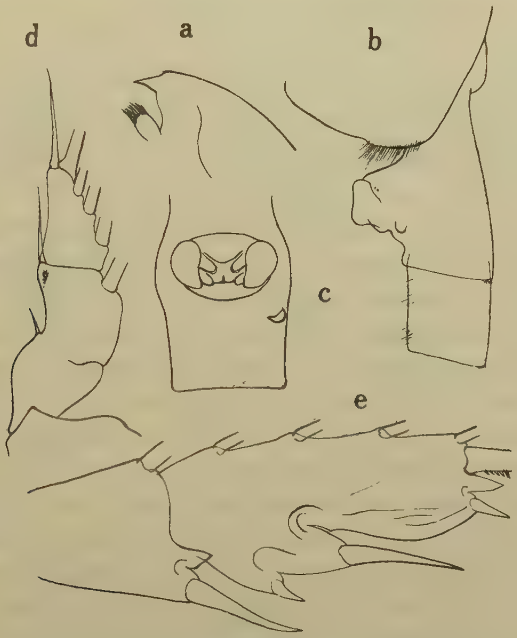

Fig. 67. *Pareuchaeta barbata* (BRADY). Female: *a*, head, lateral aspect; *b*, last thoracic segment and abdominal segments, lateral aspect; *c*, genital segment, ventral aspect; *d*, exopodite of 1st leg; *e*, exopodite of 2nd leg.

The abdomen 4-segmented; the abdominal segments and furca in the proportional lengths 42 : 21 : 23 : 4 : 10 = 100; the genital segment has a lateral tubercle on the left margin when viewed from the ventral; according to SEWELL there is no additional swelling in BRADY's specimen but FARRAN says it was impossible to see whether the lateral tubercle of the genital segment were present or not in the BRADY's original specimen. The 2nd and 3rd segments have each long hairs on the ventral surface. The furca setose; the outermost seta very minute; the appendicular seta more slender than the remaining marginal setae and about 2 times as long as the combined lengths of the abdominal segments and furca; the 2nd inner seta slightly shorter than the appendicular seta.

The 1st antenna extends to the middle of the 2nd abdominal segment when pressed to the body; the proportional lengths of the joints measured along the posterior margin are as follows:

Joint	1	2	3	4	5	6	7	8–9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24–25	
	54	43	24	22	24	24	24	30	21	19	24	38	41	49	57	57	60	70	68	60	57	54	79	=1000 ;

the proportional length of the terminal joint of the FARRAN's form measured by SEWELL is 63, and slightly shorter than the joint 19(68), whereas, according to WITH the joint 24–25 are slightly longer than the joint 19, my measurement also indicated that the joints 24–25 are longer than the joint 19; the joint 21 is 1.05 times as long as the 16th, this agrees well with SEWELL's measurement on FARRAN's form.

The outer lobe of the 1st maxilla has 5 long and 2 short setae on the right side but it has only 5 long and one short setae on the left side in the specimen dissected. The 2nd maxilla and maxillipede do not show any distinct characters.

In the 1st leg the outer marginal spine at the bottom of the concavity of the joints 1–2 of the exopodite reaches about the middle of the 2nd joint. The 2nd leg has a long outer edge spine on the 2nd joint of the exopodite; the proximal spine of the 3rd joint short, not reaching the middle of the 2nd section between the proximal and 2nd marginal spine; the 2nd marginal spine of the 3rd joint of the exopodite does not reach the distal margin of the joint; the sinus at the base of the 2nd spine reaches the line joining the base of the 1st outer marginal spine and the 2nd inner marginal seta. The mouth parts and swimming legs are of deep crimson colour.

Remarks. BRODSKY's specimen taken from the Far Eastern Seas are much larger in size than the present specimen. His specimens measured 8.0–8.4 mm in female, and have the rostrum directing straight forwards; the lateral margin of the last thoracic segment not contracted at the postero-ventral corner. The small lateral tubercle on the margin of the genital segment is illustrated in his figure showing lateral aspect but he missed it in the figure showing ventral aspect. In other respects his specimen agrees quite well with the present specimen.

Occurrence. Two females from Sagami in the vertical hauls 1000–0 m in November 1937.

Distribution. The species has been recorded from the deep waters of the Atlantic, Far-Eastern and Polar seas, and the Pacific Ocean.

Pareuchaeta malayensis Sewell

(Fig. 68, *a–h*)

Pareuchaeta barbata, A. Scott, 1909, p. 70; *Pareuchaeta malayensis*, Sewell, 1929, p. 160; Sewell, 1947, p. 121; Vervoort, 1957, p. 84.

Female. Length, 6.0–7.2 mm. The abdomen is contained 2.3–2.5 times in the length of the cephalothorax. The lateral corner of the last thoracic segment rounded but with sudden constriction of the outline near the ventro-posterior margin as figured by A. Scott. The rostrum directs downwards; the base of the rostrum rather broad. The proportional lengths of the abdominal segments and the furca are 45 : 20 : 18 : 5 : 12 = 100.

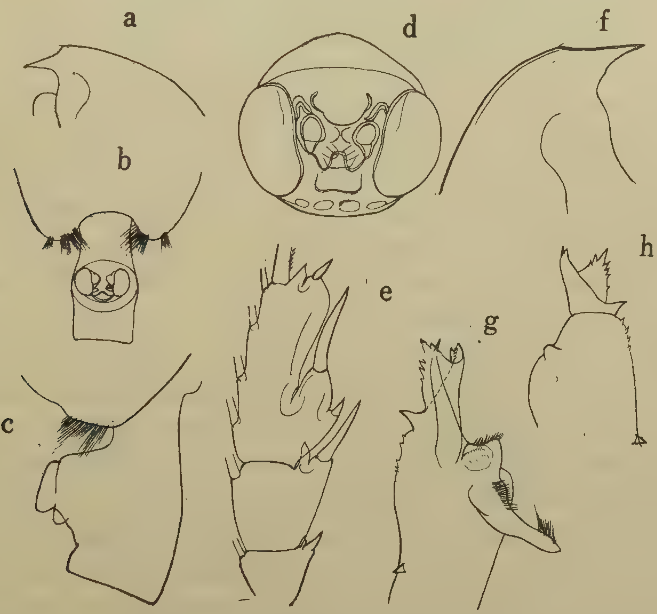

Fig. 68. *Pareuchaeta malayensis* Sewell.
Female: *a*, head, lateral aspect; *b*, last thoracic segment and genital segment, ventral aspect; *c*, last thoracic segment and genital segment, lateral aspect; *d*, genital opening, ventral aspect; *e*, exopodite of 2nd leg. Male: *f*, head, lateral aspect; *g*, 2nd joint of exopodite of left 5th leg; *h*, anterior aspect of the same joint.

The 1st antenna extends at least to the middle of the 2nd abdominal segment; the Indian specimens has the antenna reaching only the distal corner of the last thoracic segment. A. Scott's specimen has a long 1st antenna reaching the middle of the 2nd abdominal segment. The present specimen has the 1st antenna with the following proportional lengths:

Joint	1	2	3	4	5	6	7	8–9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24–25	
	44	39	23	21	26	23	26	31	18	21	23	41	39	49	60	60	62	73	76	72	57	54	78	=1000;

these lengths correspond closely with SEWELL's measurements; the distal joint is 1.4 times as long as the penultimate one; the joints 2 to 13 are fringed with fine hairs on the posterior margin.

The 2nd antenna with the exopodite 1.1 times as long as the endopodite (43 : 39). The mandible with the exopodite 1.3 times as long as the endopodite (12 : 9). The outer lobe of the 1st maxilla has 7 long and 2 short setae. The maxillae, maxillipede, 1st and 2nd legs are of crimson colour.

Male. Length, 6.19 mm. The cephalothorax, 4.37 mm; the abdomen, 1.82 mm; the abdomen is contained 2.42 times in the length of the cephalothorax. The abdominal segments and furca are in the proportional lengths 19 : 27 : 21 : 15 : 6 : 12 = 100. The frontal prominence low. The rostrum directs downwards but not vertically. The 1st abdominal segment has a dorsal process on the anterior border. The furcal setae about as long as the combined lengths of the abdominal segments and furca; the appendicular seta about half the length of the remaining marginal setae; the 2nd seta about 3 times as long as the marginal ones.

The 1st antenna extends beyond the end of the thoracic segment by last two joints; the 20th joint has no aesthetask.

In the 5th pair of legss the 1st joint of the exopodite of the right leg has a process on the outer margin; the left leg has a tooth plate which is deeply incised at the apex on the 2nd joint of the exopodite; the denticles are less in number than those of the SEWELL's specimen; the inner process of the 3rd joint of the exopodite produced into a sharp point; the middle process short.

Remarks. SEWELL named the specimen taken from the Indian Seas *P. malayensis* which he believed to be identical with the specimen of *P. barbata* A. SCOTT. In my collection there occurred the examples which resemble closely the "Siboga" specimen of *P. barbata* A. SCOTT. A comparison of my present specimen with *P. malayensis* of the Indian Seas brought some differences in the size, length of the 1st antenna, and the shape of the lateral corner of the last thoracic segment. The present specimens are closer to the "Siboga" specimen of *P. barbata* A. SCOTT than to *P. malayensis* SEWELL taken from the Indian Seas.

Occurrence. Ten females and five males were collected from Sagami and Suruga Bays from the depth 1000 m to the surface in 1937.

Distribution. The species has been recorded from the Malayan region and Indian Seas.

Pareuchaeta bisinuata G. O. SARS

(Fig. 69, *a–e*)

Euchaeta bisinuata, FARRAN, 1908, p. 45; *Pareuchaeta bisinuata*, A. SCOTT, 1909, p. 70; WITH, 1915, p. 183 G. O. SARS, 1925, p. 123; SEWELL, 1929, p. 158; JESPERSEN, 1934, p. 82; SEWELL, 1947, p. 125; WILSON, 1950, p. 276.

Female. Length, 5.5 mm: cephalothorax, 3.94 mm; abdomen, 1.56 mm. The abdomen is contained 2.56 times in the length of the cephalothorax. The last thoracic segment with bluntly rounded lateral margin which bears a postero-ventral tuft of hairs. The rostrum slender, directs straight forwards. The frontal prominence moderate.

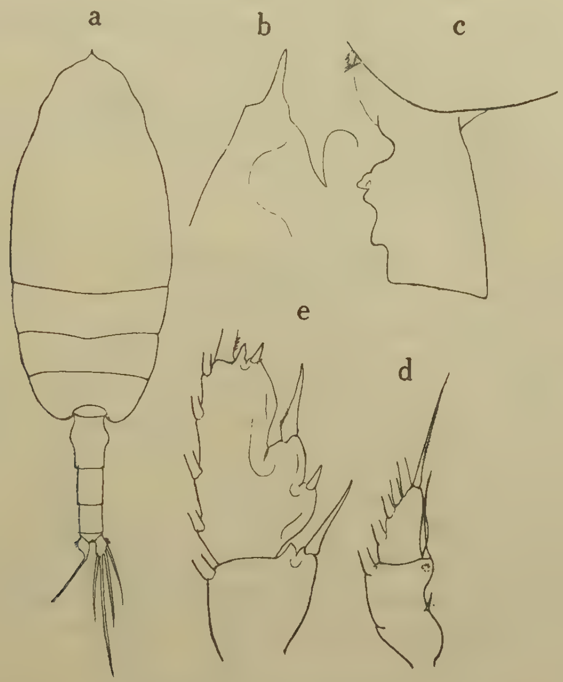

Fig. 69. *Pareuchaeta bisinuata* G. O. SARS.
Female: *a*, dorsal aspect; *b*, head, lateral aspect; *c*, last thoracic segment and genital segment, lateral aspect; *d*, exopodite of 1st leg; *e*, exopodite of 2nd leg.

The abdomen 4–segmented, the segments and furca in the proportional lengths 36 : 25 : 21 : 2 : 16 = 100. The genital protuberance slightly projects ventrally, and the ventral margin of the segment has two lobes when seen in lateral view. The 2nd and 3rd segments without hairs on the ventral surface. The 2nd inner furcal seta about 1.5 times, and the appendicular seta 3 times as long as the remaining marginal ones.

The 1st antenna 23-jointed, extends about to the end of the last thoracic segment; the distal 10 joints are in the proportional lengths:

Joint	15	16	17	18	19	20	21	22	23	24–25
	10	11	12	14	16	16	14	12	12.5	17.

The outer lobe of the 1st maxilla has 6 long setae. The other mouth parts as in *E. barbata* (BRADY).

In the endopodite of the 1st leg the articular membrane between the 1st and 2nd joints is distinct; the outer margin forms well-marked concavity; the outer marginal spine at the bottom of the concavity is fairly long. In the 2nd leg the outer edge spine of the 2nd joint of the exopodite reaches about the end of the proximal outer marginal spine of the 3rd joint; the 2nd outer marginal spine of the 3rd joint reaches the base of the 3rd spine of the same joint.

Occurrence. 2 females from Sagami in the hauls 1000–0 m, November 1937.

Distribution. The species appears to have a wide distribution, and has been recorded from the North Atlantic and Indian Oceans.

Pareuchaeta confusa sp. nov.

(Fig. 70, *a–i*)

Several species relating closely to *Euchaeta barbata* BRADY have been taken in the collection. Among them was an example which comes near to *Pareuchaeta malayensis* SEWELL. But on closer examination the species is distinct from either *P. malayensis* or *P. barbata* described by SEWELL. The species appears to be undescribed, for which I propose the name *P. confusa.*

Female. Length, 6.6–7.6 mm. The abdomen is contained 2.3–2.5 times in the length of the cephalothorax. The head boldly rounded in lateral view. The lateral corner of the last thoracic segment produced into broadly triangular process with an usual tuft of hairs. The rostrum slender, directs forwards; the frontal prominence low.

The abdomen 4-segmented, the segments and furca in the proportional lengths 41 : 24 : 21 : 3 : 11 = 100. The genital segment 1.8 times as long as wide, with lateral swellings when viewed from the dorsal; the genital boss has in lateral view a rounded lateral flange and a posterior process being separated from the former by incision which is the posterior limitation of the genital opening; in ventral view it is covered by the rounded lateral flanges; within these plates chitinous plates of complicated structure are observed; the distal margin of the genital segment has short hairs on the ventral surface. The 2nd segment has poor hairs on the dorsal, but it is very setose on the ventral. The 3rd and 4th segments are also setose on the ventral. The 2nd furcal seta about 2 times as long as the marginal ones; the appendicular seta long and slender.

The 1st antenna 23-jointed, extends to the lateral corner of the last thoracic segment; the joints are in the following proportional lengths:

Joint	1	2	3	4	5	6	7	8–9	10	11	12	13	14	15
	45	37	25	23	25	25	25	34	23	23	31	39	42	48
	16	17	18	19	20	21	22	23	24–25					
	62	59	62	70	67	64	56	48	67 =1000;					

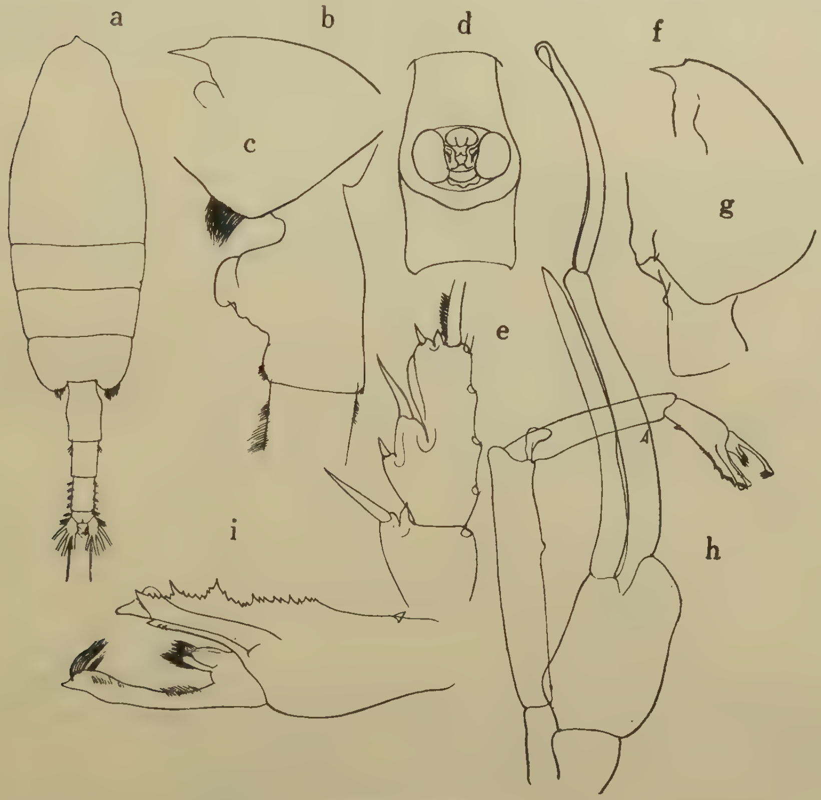

Fig. 70. *Pareuchaeta confusa* sp. nov.

Female: *a*, dorsal aspect; *b*, head, lateral aspect; *c*, last thoracic segment and abdominal segments, lateral aspect; *d*, genital segment, ventral aspect; *e*, exopodite of 2nd leg. Male: *f*, head, lateral aspect; *g*, last thoracic segment and genital segment, lateral aspect; *h*, 5th pair of legs; *i*, terminal joints of left 5th leg.

the distal joint is 1.36 times as long as the penultimate one; the 21st is 1.08 times as long as the 17th; in the specimen which SEWELL believed to be an example of *Euchaeta barbata* BRADY the distal joint is 1.32 times as long as the penultimate one, and in *P. malayensis* it is 1.48 times; the present specimen is near to *P. barbata* described by SEWELL in the proportional lengths of the joints of the 1st antenna. My specimen of *P. malayensis* is furnished with fine hairs on the posterior margin of the joints 2 to 15 of the 1st antenna but in the present specimen these hairs are observed on the joints 2 to 13.

The 2nd antenna, mandible, maxillae and maxillipede as in *P. malayensis*. The outer lobe of the 1st maxilla has 7 long and 2 short setae.

The 1st leg as in the foregoing species. In the 2nd leg the marginal spine of the 2nd joint of the exopodite reaches half-way to the proximal spine of the 3rd joint; the proximal spine of the 3rd joint reaches half-way to the base of the 2nd spine; the 2nd spine of the 3rd joint reaches the distal margin of the joint; the sinus at the base of the 2nd spine is deep but the bottom of the sinus falls short of the line drawn between the base of the proximal spine and the 2nd inner marginal seta.

Male. Length, 6.00–7.00 mm. The abdomen is contained about 1.9 times in the length of the cephalothorax; the lateral corner of the last thoracic segment more produced on the right side than on the left. The rostrum directs slightly downwards.

The abdomen 5–segmented; the segments and furca are in the proportional lengths 24 : 32 : 29 : 21 : 5 : 8 = 100. The 1st segment has on the anterior border dorsal process which can be seen more distinctly from the left side. The 2nd, 3rd and 4th segments are furnished with coarse teeth on the posterior margin. Tthe 2nd furcal seta about 1.5 times, the appendicular seta half the length of the marginal setae.

The 1st antenna extends beyond the end of the last thoracic segment by distal one joint; the joints are in the following proportional lengths:

Joint	1	2	3	4	5	6	7	8–9–10	11	12–13	14	15
	51	37	20	22	26	29	37	73	26	70	40	48

16	17	18	19	20	21	22	23	24–25	
55	55	59	66	62	59	55	40	70	=1000;

the joint 19 is slightly shorter than the joints 24–25; no aesthetask on the 20th.

The mouth parts are reduced; the outer lobe of the 1st maxilla has 5 long setae; the endopodite of the same appendage has 6 setae.

The 1st leg has 3–jointed exopodite and 1–jointed endopodite; the 1st joint of the exopodite with a minute outer edge spine. In the 2nd leg leg the outer edge spine of the 2nd joint of the exopodite short; the 2nd spine of the 3rd joint reaches half-way to the 3rd division.

The 5th pair of legs resemble those of *P. barbata* BRADY, but more irregular denticles of the tooth plate of the 2nd joint distinguishes the present specimen from the former; in the 3rd joint of the exopodite the inner process dilated at the distal end; the middle process rather slender as compared with that of *P. malayensis*.

Remarks. The present specimen resembles most closely *P. malayensis* in the structure of the maxillae, maxillipede and swimming legs, but can be distinguished from it by the shape of the rostrum, the proportional lengths of the joints of the 1st antenna, and somewhat shallow sinus of the 3rd joint of the 3rd exopodite of the 2nd leg. In the male 5th pair of legs the tooth plate of the 2nd joint of the exopodite of the left leg, and the inner process of the 3rd joint of the exopodite are of characteristic features. The present species resembles also *E. propinqua* ESTERLY in the shape of the last thoracic segment and genital segment, but the slender rostrum and small size distinguish the species from the former. The species also comes near to *P. polaris* BRODSKY but the 2nd outer edge spine of the 3rd joint of the exopodite is much longer, reaching the base of the distal outer edge spine of the same joint.

Occurrence. 15 females and 3 males were collected from 1000–0 m., from Sagami and Suruga, November 1938.

Pareuchaeta calva sp. nov.

(Fig. 71, *a–f*)

Female. Length, 7.44 mm: the cephalothorax, 5.31 mm; abdomen, 2.31 mm. The abdomen is contained 2.5 times in the length of the cephalothorax. The profile of the head rather straight; the rostrum slender, directs straight forwards. The posterior thoracic margin is rounded, and is provided with a tuft of short hairs instead of usual long ones.

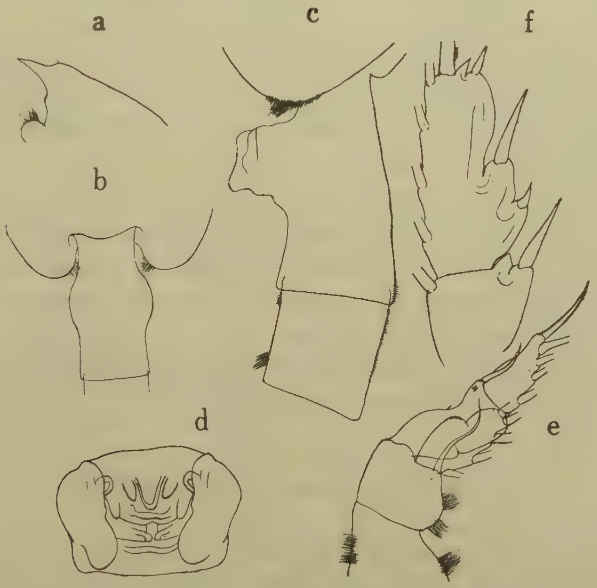

Fig. 71. *Pareuchaeta calva* sp. nov.
Female: *a*, head, lateral, aspect; *b*, last thoracic segment and abdominal segments, lateral aspect; *d*, genital opening, ventral aspect; *e*, 1st leg; *f*, exopodite of 2nd leg.

The abdomen 4-segmented; the first three segments have the proportional lengths 19:10:9. The genital protuberance as that of *P. sarsi* (FARRAN) but the posterior margin of the genital flanges more produced than that of *P. sarsi* when viewed from the lateral; the 2nd segment is furnished with scattered short hairs on the dorsal and proximal ventral surface. The 3rd segment with short hairs on the dorsal surface; the ventral surface of the same segment has long hairs forming three groups. The appendicular seta slender and long.

The 1st antenna 23-jointed, extends to the posterior margin of the last thoracic segment; the joints are in the proportional lengths:

Joint	1	2	3	4	5	6	7	8–9	10	11	12	13	14	15
	32	31	22	19	22	25	25	35	22	22	32	41	41	51

	16	17	18	19	20	21	22	23	24–25	
	60	60	60	71	73	67	60	54	74	=1000;

the joints 24–25 are 1.35 times as long as the penultimate; the joint 19 is slightly longer than the joints 24–25; the joint 21 is 1.1 times as long as the joint 17.

The outer lobe of the 1st maxilla has 5 long setae and 2 minute spines. The other mouth parts do not show any characteristic features.

The 1st leg as that of the preceding species. In the 2nd leg the outer edge spine of the 2nd joint of the exopodite reaches about the end of the proximal spine of the 3rd joint; the proximal spine of the 3rd joint reaches the middle of the 2nd division of the same joint; the 2nd spine of the 3rd joint does not reach the distal margin of the 3rd joint.

Remarks. The present species closely resembles *P. sarsi* (FARRAN) but differs from it in the followings: smaller in size, rather slender rostrum, poor hairs on the lateral corner of the last thoracic segment, the shape of the genital protuberance, and the proximal marginal spine of the exopodite of the 3rd joint of the 2nd leg reaching only half-way to the base of the 2nd spine.

Occurrence. 5 females, July 1937 in Suruga, and one female, November 1937 in Sagami, form the depth 1000 m to the surface.

Pareuchaeta aequatorialis nom. nov.

(Fig. 72, *a–g*)

Euchaeta scotti, WOLFENDEN (non *E. scotti* FARRAN), 1911, p. 301, pl. 35.

Several examples were taken in the collection, which seems to be identical with *E. scotti* described by WOLFENDEN in the South Polar Expedition (1911). But on closer examination his species is quite distinct from that originally described by FARRAN under the name *Euchaeta scotti* from the west coast of Ireland. And I propose the name *P. aequatorials* for the form described by WOLFENDEN from the equatorial region of the Atlantic.

Female. Length, 5.30 mm: cephalothorax, 3.30 mm; abdomen, 1.60 mm. The abdomen is contained 2.3 times in the length of the cephalothorax. The body robust, the cephalothorax about 1.4 times as long as wide. The last thoracic segment bluntly triangular with an usual tuft of hairs on the lateral corner; the postero-ventral margin of the segment slightly contracted in outline when seen from the lateral. The rostrum directs forwards and slightly downwards; the frontal prominence high.

The proportional lengths of the first three abdominal segments are 39 : 19 : 18. The lateral flanges of the genital opening resemble those of *E. scotti* FARRAN but there is no dorso-lateral ridge on the left side about the middle of the genital segment as is observed in *E. scotti*. The 2nd and 3rd segments have each coarse hairs on the ventral surface; the distal margin of the segments are fringed with coarse teeth. The anal segment has a tuft of hairs on the ventral. The appendicular seta about 3 times as long as the marginal setae.

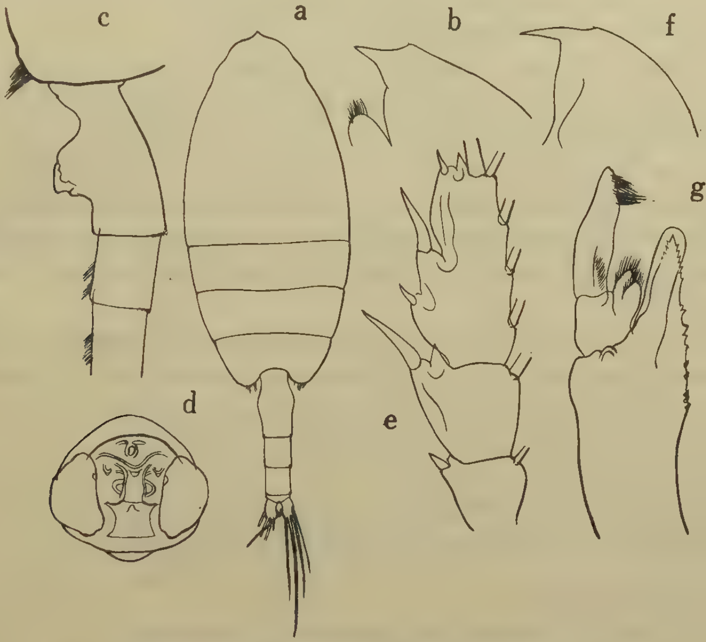

Fig. 72. *Pareuchaeta aequatorialis* nom. nov.
Female: *a*, dorsal aspect; *b*, head, lateral aspect; *c*, last thoracic segment and abdominal segments, lateral aspect; *e*, exopodite of 2nd leg. Male: *f*, head, lateral aspect; *g*, terminal joints of left 5th leg.

The 1st antenna 23-jointed, extends to the middle of the last thoracic segment; the joints are in the proportional lengths:

Joint	1	2	3	4	5	6	7	8–9	10	11	12	13	14	15
	28	56	31	25	28	25	30	31	19	19	31	44	44	47
	16	17	18	19	20	21	22	23	24–25					
	53	53	61	70	70	65	56	53	61	=1000;				

the distal joint is 1.16 times as long as the penultimate one, whereas, it is 1.50 times in *E. scotti*; the joint 21 is 1.24 times as long as the 17th, whereas, it is only 1.04 times in *E. scotti*.

The outer lobe of the 1st maxilla has 5 long setae. The other mouth parts as those of *E. barbata* BRADY.

The 1st leg has hairs on the outer margin of the 1st basal joint; the outer marginal spine at the bottom of the concavity of the joints 1–2 of the exopodite is very short; the outer edge spine of the 2nd joint extends just to the distal margin of the 3rd joint. In the exopodite of the 2nd leg the outer edge spine of the 2nd joint reaches about the end of the proximal outer marginal spine of the 3rd joint; the same spine of *E. scotti* is short, not reaching the end of the proximal spine; the 2nd outer marginal spine of the 3rd joint does not reach the base of the 3rd spine of the joint; the sinus at the base of the 2nd outer marginal spine is not deep.

Male. Length, 4.70 mm: cephalothorax, 3.25 mm; abdomen, 1.45 mm. The last thoracic segment rounded laterally; the left side is more produced than the right. The rostrum slender, directs downwards.

The abdomen 5–jointed; the segments and furca in the proportional lengths 24:25:21:16:5:9=100; the 1st segment has a dorsal swelling on the anterior border; the 2nd, 3rd and 4th segments are fringed with coarse teeth on the posterior margin. The 2nd furcal seta 1.5 times, the appendicular seta about as long as the marginal setae.

The 1st antenna 21–jointed, extends beyond the posterior margin of the thoracic segment by distal one joint; the proportional lengths of the joints as follows:

Joint	1	2	3	4	5	6	7	8–9–10	11	12–13	14
	60	40	23	20	25	30	35	75	25	60	43
	15	16	17	18	19	20	21	22	23	24–25	
	43	50	52	58	63	63	58	58	52	67	=1000;

no aesthetask on the joint 20.

The mouth parts do not show any characteristic features.

The 1st leg has no outer edge spine on the 1st joint of the exopodite. In the 2nd leg the 2nd outer edge spine of the 3rd joint is the longest, reaching the middle of the 3rd division.

In the 5th pair of legs the terminal joints of the left leg as shown in the figure; the tooth plate of the 2nd joint of the exopodite of the left leg is furnished with irregular denticles along the inner margin; the 1st joint of the exopodite of the right leg has a spine on the outer margin.

Remarks. The present species closely resembles *E. scotti* FARRAN but can be distinguished from it by the followings: somewhat slender rostrum; the more complicated structure of the genital opening; absence of dorso-lateral ridge on the genital segment; the proportional lengths of the joints of the 1st antenna; 5 long setae on the outer lobe of the 1st maxilla ; the short outer edge spine of the 2nd joint of the exopodite of the 2nd leg, not reaching the end of the proximal outer marginal spine of the 3rd joint ; in the male the serrated plate of the 2nd joint of the exopodite of the left 5th leg is characteristic. SEWELL included WOLFENDEN's *scotti* in his proposed Group II which bears 7 setae on the Le. 1 of the 1st maxilla but it is incorrect ; WOLFENDEN's *scotti* has, as WOLFENDEN describes, only 5 setae on the Le. 1 of the 1st maxilla.

Occurrence. 7 females and 3 males from Sagami and Suruga collection in the vertical hauls 1000–0 m, November and December 1937.

Distribution. The species has been recorded from the equatorial region of the Atlantic.

Pareuchaeta sarsi (FARRAN)

(Fig. 73, *a–j*)

Euchaeta sarsi FARRAN, 1908, p. 41 ; *Pareuchaeta dentata* A. SCOTT, 1909 (male) ; *Euchaeta sarsi*, WITH, 1915, p. 177 ; *Pareuchaeta sarsi*, SARS, 1925, p. 114 ; SEWELL, 1947, p. 127 ; WILSON, 1950, p. 284 ; VERVOOT, 1957, p. 84.

Female. Length, 8.3–9.7 mm. The abdomen is contained 2.3 times in the length of the cephalothorax. The lateral corner of the last thoracic segment rounded, and is furnished each with a tuft of hairs. The rostrum directs forwards and somewhat downwards.

The first three abdominal segments have the proportional lengths 19 : 10 : 10. The genital protuberance as figured by Farran in lateral aspect ; in dorsal view the lateral margins of the segment have a considerable swelling on each side about the middle. The 2nd and 3rd segments with scattered hairs on the dorsal surface, but they are very setose on the ventral surface. The 2nd furcal seta is about 3 times, the appendicular seta 6 times as long as the marginal ones.

The 1st antenna 23 jointed, extends about to the end of the cephalothorax ; the joints are in the proportional lengths :

Joint	1	2	3	4	5	6	7	8–9	10	11	12	13	14
	42	42	24	21	26	26	26	35	21	24	30	39	40
	15	16	17	18	19	20	21	22	23	24–25			
	51	58	58	61	68	68	63	58	51	66	=1000.		

The outer lobe of the 1st maxilla has, beside 5 long setae and 2 minute spinules, 1 short seta proximally ; the 2nd basal joint has 5, the endopodite 9 setae.

In the 1st leg there is a minute spine at the fusion of the 1st and 2nd joints of the exopodite. In the exopodite of the 2nd leg the outer edge spine of the 2nd joint reaches half-way to the proximal spine of the 3rd joint ; the 2nd spine of the 3rd joint reaches the 5/6 of the distal section ; the sinus at the base of the 2nd spine is not deep.

Male. Length, 6.94–7.71 mm. The abdomen is contained 2.3 times in the length of the cephalothorax. The last thoracic segment asymmetrical; the left side is more produced. The rostrum directs downwards. The proportional lengths of the abdominal segments and the furca are 22 : 27 : 25 : 17 : 2 : 7 = 100. The 1st abdominal segment has a dorsal process near the anterior border; it is more prominent when seen from the right than from the left side. The 2nd and 3rd segments are armed dorsally with coarse teeth, the posterior margin The 2nd furcal seta is about 1.5 times, and the appendicular seta about half the length of the marginal ones.

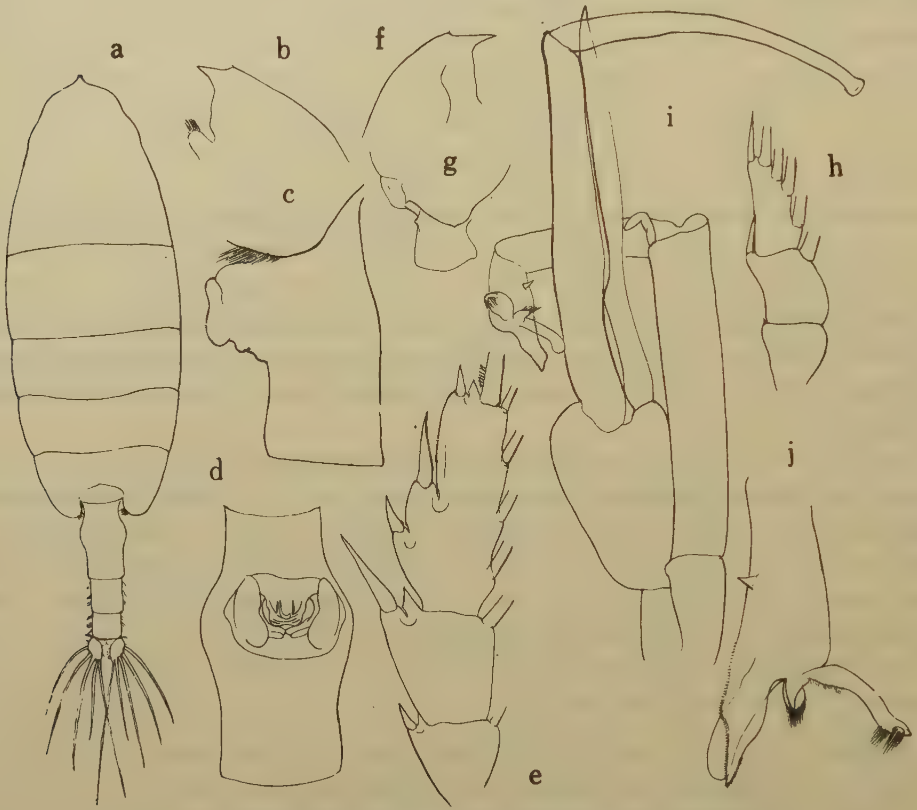

Fig. 73. *Pareuchaeta sarsi* (FARRAN).
Female: *a*, dorsal aspect, *b*, head, lateral aspect; *c*, last thoracic segment and genital segment, lateral aspect; *d*, genital segment, ventral aspect; *e*, exopodite of 2nd leg. Male: *f*, head, lateral aspect; *g*, last thoracic segment and genital segment, lateral aspect; *h*, exopodite of 1st leg; *i*, 5th pair of legs; *j*, terminal joints of left 5th leg.

The 1st antenna 21–jointed, extends just beyond the end of the cephalothorax; the joints 8, 9 and 10 are fused; the joints 12–13 are fused on the posterior margin; the proportional lengths of the joints are as follows:

Joint	1	2	3	4	5	6	7	8–9–10	11	12–13	14	15	16	17	18	19	20	21	22	23	24–25	
	47	34	20	20	27	28	34	75	25	67	38	48	57	57	67	67	67	60	57	51	67	=1000.

The mouth parts are somewhat reduced. The outer lobe of the 1st maxilla has 5 long setae.

The 1st leg has 3-jointed exopodite and 1-jointed endopodite; the hairs on the outer margin of the 1st basal joint are wanting; the 1st joint of the exopodite with a minute outer edge spine. In the 2nd leg the outer edge spine of the 2nd joint of the exopodite reaches half-way to the base of the proximal spine of the 3rd joint; the 2nd spine of the 3rd joint does ont reach the middle of the 3rd division. The 5th pair of legs agree quite well with the figures given by SARS; the thumb on the distal end of the left leg is lanceolated.

Remarks. *P. dentata* described by A. SCOTT in the "Siboga" Expedition appears to be identical with the male of *P. sarsi*. The male of *P. sarsi* described by A. SCOTT is a quite different species.

Occurrence. 28 females and 8 males in 8 vertical hauls from 1000 m to the surface in Suruga; 5 females in the haul from 1260 m to the surface in Suruga, December 1937; 1 female from Sagami, November 1937 from 1000–0 m.

Distribution. The species has a wide distribution in the deep waters of waters the Pacific, Atlantic, and Indian Oceans.

Pareuchaeta scotti (FARRAN)

(Fig. 74, *a–j*)

Euchaeta scotti, FARRAN, 1908, p. 42; WITH, 1915, p. 179; *Pareuchaeta scotti*, SARS, 1925, p. 116; JESPERSEN, 1934, p. 81; SEWELL, 1947, p. 125; WILSON, 1950, p. 284.

Female. Length, 5.00 mm. The cephalothorax, 3.56 mm, the abdomen, 1.44 mm; the abdomen is contained 2.5 times in the length of the cephalothorax. The lateral corner of the last thoracic segment bluntly triangular in lateral view, and are furnished with an usual tuft of hairs. The rostrum heavy, directs somewhat downwards; the frontal prominence low.

The abdomen 4-segmented, the segments and furca in the proportional lengths 48 : 18 : 19 : 7 : 8 = 100. The genital segment slightly asymmetrical when viewed from the dorsal; the right lateral margin is somewhat inflated about the middle; there is a dorso-lateral ridge, which is clearly figured by FARRAN (pl. III, fig. 11); the genital protuberance has a small lateral flanges; the distance between the posterior limit of the vulva and the distal margin of the segment is much longer than that of *P. aequatorialis* nom. nov. The 2nd and 3rd segments are furnished with short hairs only on the ventral surface.

The 1st antenna 23-jointed, reaches the middle of the 3rd thoracic segment; the joints are in the proportional lengths:

Joint	1	2	3	4	5	6	7	8–9	10	11	12	13	14
	51	41	26	21	26	26	28	36	23	23	28	44	41

15	16	17	18	19	20	21	22	23	24–25	
46	57	57	59	64	64	59	57	51	77	=1000;

the distal joint is 1.5 times as long as the penultimate one; the 21st is 1.04 times as long as the 17th.

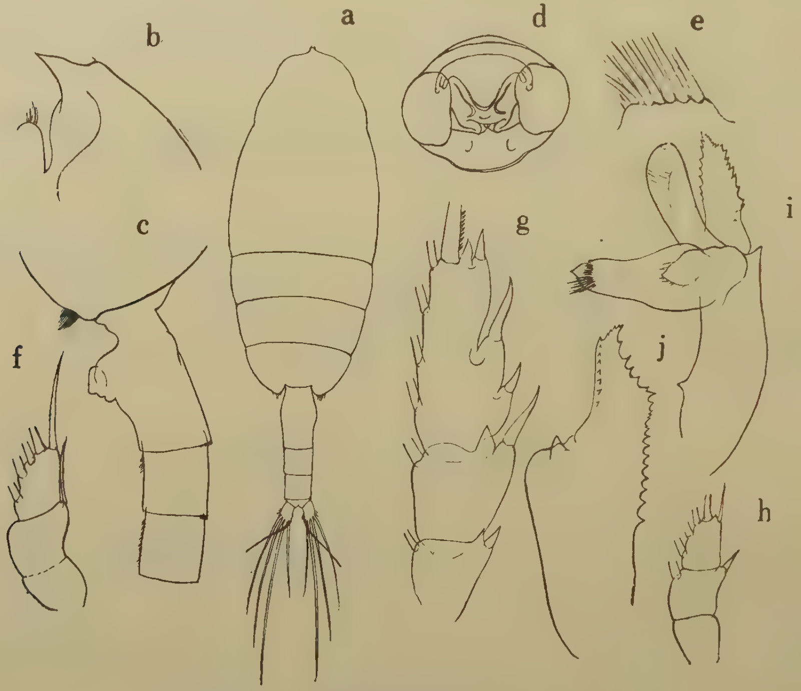

Fig. 74. *Pareuchaeta scotti* (FARRAN).
Female: *a*, dorsal aspect; *b*, head, lateral aspect; *c*, last thoracic segment and abdominal segments, lateral aspect; *d*, genital opening, ventral aspect; *e*, outer lobe of 1st maxilla; *f*, exopodite of 1st leg; *g*, exopodite of 2nd leg. Male: *h*, exopodite of 1st leg; *i*, terminal joints of left 5th leg; *j*, tooth-plate of the same joint.

In the 1st maxilla the outer lobe has 7 long and 2 short setae. The other mouth parts do not show any characteristic features.

In the 1st leg the 1st and 2nd joints of the exopodite are separate on the anterior surface; the outer edge spine of the concavity is very small; the outer edge spine of the 2nd joint exceeds the distal margin of the 3rd joint. In the 2nd leg the outer edge spine of the 2nd joint of the exopodite does not reach the end of the proximal spine of the 3rd joint.

Male. Length, 4.75 mm. The cephalothorax, 3.32 mm; the abdomen, 1.25 mm. The lateral corner of the last thoracic segment more produced on the left than on the right. The rostrum rather heavy.

The 1st antenna extends beyond the end of the thoracic segment.

The 1st leg has 3-jointed exopodite; the 1st joint of the exopodite has no outer edge spine; the outer edge spine of the 2nd and the 3rd joints are short. The 5th pair of legs as figured by WITH; the serrated plate on the 2nd joint of the exopodite of the left leg as shown in the figure.

Remarks. The Pacific specimen, though slightly smaller in size, agree quite well with the description and figures given by FARRAN. WOLFENDEN's specimen taken from the tropical Atlantic is not identical with FARRAN's specimen of *P. scotti*; to the former I proposed the name *P. aequatorialis*.

Occurrence. One female and a male from deep waters of Sagami, November 1938.

Distribution. The species has been recorded from the North Atlantic and the Arabian Sea, and also from the Pacific.

Pareuchaeta elongata (ESTERLY)

(Fig. 75, *a–i*)

Euchaeta elongata, ESTERLY, 1913, p. 182; *E. japonica*, MARUKAWA, 1921, p. 11; MORI, 1937, p. 47, BRODSKY, 1950, p. 209.

Female. Length, 6.81–7.39 mm. The abdomen is contained 2.3 times in the length of the cephalothorax. The lateral corner of the last thoracic segment produced into knob-like process. The rostrum slender, directs straight forwards and slightly downwards; the frontal prominence low.

The proportional lengths of the first three abdominal segments in 0.01 mm. are 97 : 52 : 43. The genital protuberance is not deep; the lateral flanges of the genital protuberance asymmetrical with a lamella at the right side of the orifice; the 2nd and 3rd segments are fringed with rather coarse teeth on the dorsal distal margin; the ventral surface of the segments are devoid of hairs. The anal segment very short consealed under the preceding segment, and has a tuft of hairs on the ventral surface. The ordinal furcal setae about as long as the combined lengths of the last three abdominal segments and furca; the 2nd seta about 2 times, and the appendicular seta 4 times as long as the marginal ones.

The 1st antenna reaches the end of the last thoracic segment; the joints are in 0.01 mm as follows:

Joint	1	2	3	4	5	6	7	8–9	10	11	12	13	14
	15	10	6	6	7	7	8	11	8	9	11	15	14

15	16	17	18	19	20	21	22	23	24–25
15	17	17	18	22	22	19	17	15	20.

The mouth parts as in *E. barbata*. The outer lobe of the 1st maxilla has 7+2 setae.

In the 1st leg the 1st basal joint without hairs on the outer margin; the articular membrane between the 1st and 2nd joints of the exopodite is obscure; the outer marginal spine at the bottom of the concavity absent. In the exopodite of the 2nd leg the outer edge spine of the 2nd joint reaches the base of the proximal spine of the 3rd joint; the 2nd outer marginal spine of the 3rd joint reaches about the distal margin of the joint.

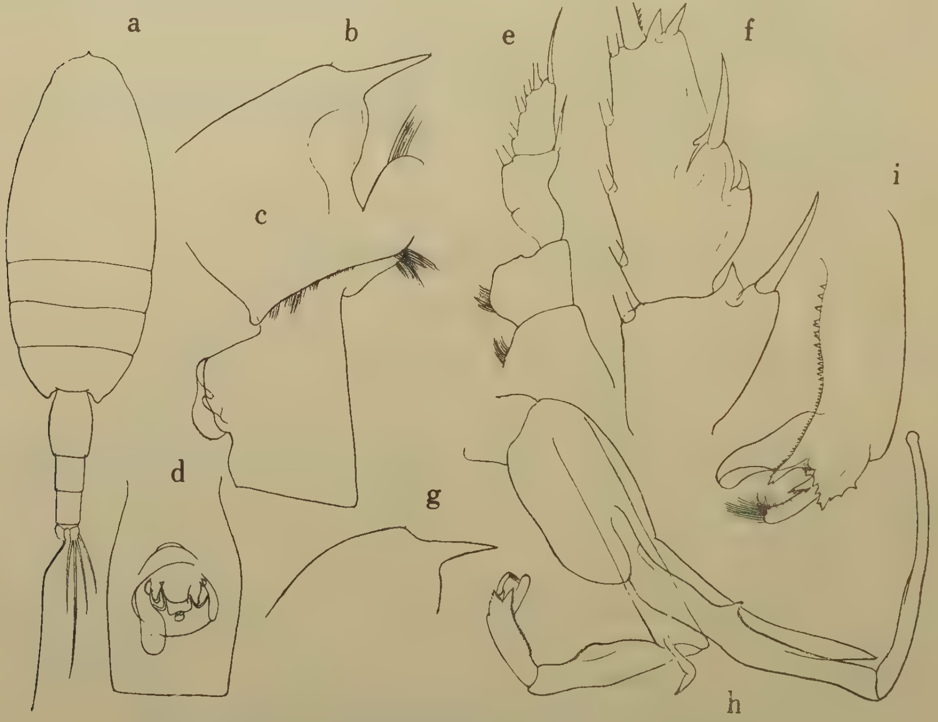

Fig. 75. *Pareuchaeta elongata* (ESTERLY).
Female: *a*, dorsal aspect; *b*, head, lateral aspect; *c*, last thoracic segment and genital segment, lateral aspect; *d*, genital segment, ventral aspect; *e*, exopodite of 1st leg; *f*, exopodite of 2nd leg. Male: *g*, head, lateral aspect; *h*, 5th pair of legs; *i*, terminal joints of left 5th leg.

Male. Length, 6.28 mm. The cephalothorax, 4.40 mm; the abdomen, 1.88 mm. The rostrum long, directs downwards; the frontal prominence low. The first abdominal segment has a dorsal process near the anterior border. The furcal setae about as long as the combined lengths of the last four abdominal segments and furca; the proportional lengths of the 2nd, appendicular, and the other marginal setae are 37 : 15 : 22.

The 1st antenna extends beyond the end of the last thoracic segment by terminal two joints ; the 20th joint without aesthetask.

The 5th pair of legs as shown in the figure.

Remarks. The specimen, though larger in size than those from the San Diego region, agrees well with the description of the female of *E. elongata. E. japonica* MARUKAWA from the Sea of Japan is clearly identical with *E. elongata* ESTERLY. The female specimen can be easily distinguished by the shape of the last thoracic segment and the genital boss. ESTERLY's specimen measured 4.13 mm. ; those from the Japanese waters measured about 8.00 mm. in the female, and 8.40 mm. in the male ; the specimen from the Far-Eastern Sea measured 6.3–6.5 mm in the female, and 5.5–6.2 mm. in the male.

Occurrence. 3 females and one male in November 1937, and one female in April 1938 in from the depth 1000–0 m Sagami Bay.

Distribution. The species is distributed in the North Pacific and North Polar Sea. It has been recorded from the waters below the depth 200 fathoms in the Japan Sea and from the depth 240-120 fathoms near Hokkaido. The specimen of the Izu region might have been brought down into Sagami Bay by the cold intermediate water of the Oyashio current. It has not been obtained from Suruga Bay.

Pareuchaeta crassa sp. nov.

(Fig. 76, *a–i*)

Female. Length, 6.95–7.25 mm. The abdomen is contained 2.3 times in the length of the cephalothorax. The cephalothorax robust, about half as wide as long. The lateral corner of the last thoracic segment bluntly triangular with a tuft of long hairs. The rostrum broad ; the frontal prominence low.

The fiirst 3 abdominal segments in 0.01 mm are 100 : 50 : 37. The genital segment has 2 low tubercles closely set together on the left side, slightly anterior to the base of the genital boss ; the right side has also a low tubercle opposite to those of the left ; the genital protuberance is not deep ; the lateral flanges rounded and produced posteriorly. The 2nd and 3rd segments are furnished with hairs on the ventral surface ; the posterior margin of the segments are fringed with groups of fine spinules. The 2nd furcal seta about 1.5 times as long as the remaining marginal ones ; the appendicular seta slender and long.

The 1st antenna 23–jointed, reaches the posterior margin of the last thoracic segment ; the joints are in the proportional lengths :

Joint	1	2	3	4	5	6	7	8–9	10	11	12	13	14
	46	46	25	23	27	29	25	34	20	21	27	43	39
	15	16	17	18	19	20	21	22	23	24–25			
	46	57	61	61	68	64	61	57	52	68	=1000 ;		

the 17th joint is as long as the 21st; the 19th joint as long as the 24–25th. The outer lobe of the 1st maxilla with 6 long and 1 short setae.

In the 1st leg the articular membrane between the 1st and 2nd joints of the exopodite can be clearly observed on the anterior surface; the 1st joint of the exopodite with a minute outer edge spine at the bottom of the concavity. In the 2nd leg the outer edge spine on the 2nd joint of the exopodite reaches a point half-way to the proximal outer edge spine of the 3rd joint; the 2nd spine of the 3rd joint does not reach the distal margin of the joint.

Male. Length, 6.19 mm. The cephalothorax, 4.25 mm; the abdomen, 1.94 mm. The abdomen is contained 1.94 times in the length of the cephalothorax. The frontal prominence low; the rostrum heavy, directs forwards and somewhat downwards. The 1st abdominal segment has a dorsal process on the anterior border. The furcal setae about as long as the combined lengths of the abdominal segments and the furca; the appendicular seta half the length of the marginal ones. The 1st antenna extends to the end of the thoracic segment; the 20th joint has an aesthetask. In the 5th pair of legs the outer margin of the 1st joint of the exopodite of the right leg is smooth;

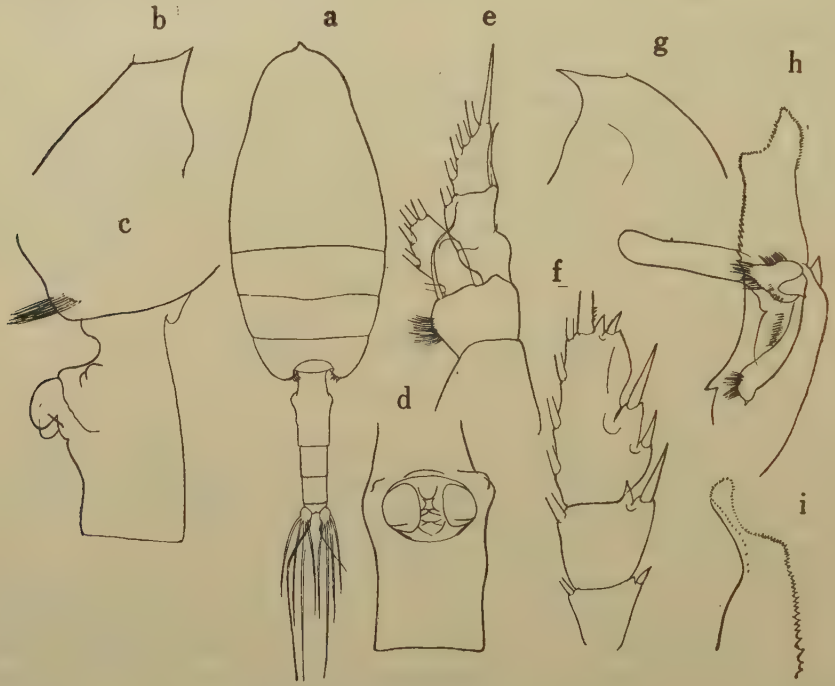

Fig. 76. *Pareuchaeta crassa* sp. nov.
Female: *a*, dorsal aspect; *b*, head, lateral aspect; *c*, last thoracic segment and genital segment, lateral aspect; *d*, genital segment, ventral aspect; *e*, 1st leg; *f*, exopodite of 2nd leg. Male: *g*, head, lateral aspect; *h*, terminal joints of left 5th leg; *i*, tooth-plate of the same joint.

the distal joint of the left leg as figured.

Remarks. The shape of the genital segment distinguishes the species from any of hitherto known species.

Occurrence. 5 females and 1 male in November 1937, and 3 females in April 1938 in the vertical hauls from 1000–0 m in Sagami Bay.

Pareuchaeta birostrata BRODSKY

(Fig. 77, *a–i*)

Pareuchaeta birostrata, BRODSKY, 1950, p. 213, fig. 127.

Female. Length, 7.39–8.13 mm. The abdomen is contained 2.5 times in the length of the cephalothorax. The lateral corner of the last thoracic segment rounded, and is furnished with a tuft of long hairs. The rostrum directs straight forwards; the frontal prominence high.

The abdomen 4–segmented, the segments and furca in the proportions 46 : 21 : 19 : 3 : 11 = 100. The genital segment has lateral swellings about the middle and has a small tubercle on the left side of the segment slightly anterior to the base of the genital boss when viewed from the ventral; the genital protuberance deep; the lateral flanges straight in lateral aspect. The marginal anal segment very short, concealed beneath the preceding. The furcal setae about as long as the combined lengths of the 1st and 2nd abdominal segments together; the 2nd seta about 1.5 times, the appendicular seta 2.5 times as long as the remaining marginal one.

The 1st antenna 23–jointed, extends just beyond the end of the cephalothorax; the joints as in the following proportional lengths:

Joint	1	2	3	4	5	6	7	8–9	10	11	12	13	14
	51	42	22	19	25	25	25	31	20	20	25	39	29

Joint	15	16	17	18	19	20	21	22	23	24–25	
	48	59	62	62	73	70	62	62	51	68	= 1000;

the 17th joint is about as long as the 21st; the 19th joint is longer than the 24–25th which is 1.34 times as long as the penultimate one. The outer lobe of the 1st maxilla has 7 long and 2 short setae. The other mouth parts do not show any characteristic features.

In the 1st leg the articular membrane between the 1st and the 2nd joints of the exopodite are barely indicated; the outer edge spine of the 3rd joint is slneder, about 1.6 times as long as the 3rd joint itself. In the 2nd leg the outer edge spine of the 2nd joint of the exopodite reaches the middle of the proximal spine of the 3rd joint; the 2nd spine of the 3rd joint falls short of the base of the 3rd spine; the sinus at the base of the 2nd spine is deep that it reaches the line joining the base of the 1st outer edge spine and the 2nd inner edge seta.

Male. Length, 6.39 mm. The cephalothorax, 4.45 mm, the abdomen, 1.94 mm, so the abdomen is contained 2.3 times in the length of the cephalothorax. The rostrum directs downwards; the frontal prominence low. The proportional lengths of the first four segments are 20 : 35 : 29 : 20. The 1st segment has a dorsal swelling near the anterior border. The ordinary marginal furcal setae about as long as the combined lengths of the abdominal segments and furca; the appendicular seta 2/3 the length of the marginal ones.

The 1st antenna exceeds just beyond the end of the last thoracic segment; the 20th joint has no aesthetask.

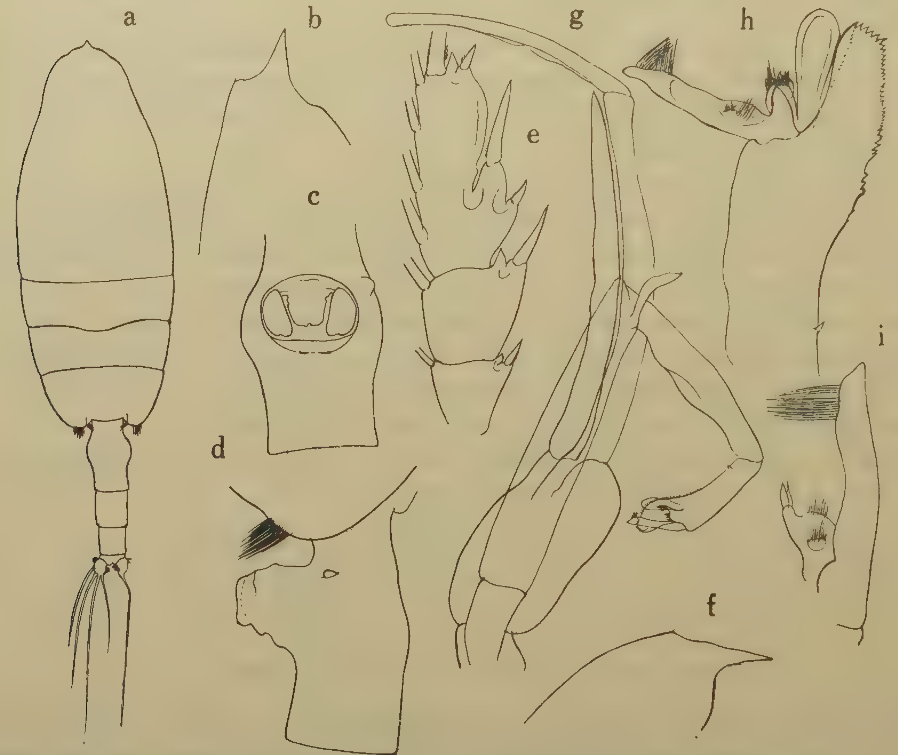

Fig. 77. *Pareuchaeta birostrata* Brodsky.
Female: *a*, dorsal aspect: *b*, head, lateral aspect; *c*, genital segment, ventral aspect; *d*, last thoracic segment and genital segment, lateral aspect; *e*, exopodite of 2nd leg. Male: *f*, head, lateral aspect; *g*, 5th pair of legs; *h*, termintal joints of left 5th leg; *i*, 3rd joint of exopodite of left 5th leg.

In the left 5th leg the middle process of the 3rd joint of the exopodite is peculiarly shaped as shown in the figure.

Remarks. The species closely resembles *E. californica* Esterly but the female specimen can be distinguished from the former in the followings: the proportional length of the 1st antenna; the length of the outer edge spine of the 2nd joint of the exopodite of the 2nd leg, in *E. californica* the spine exceeds well beyond the end of the proximal outer marginal spine of the 3rd joint, whereas, it is much shorter in the present species; furthermore, the 2nd outer marginal spine of the 3rd joint of the exopodite of the 2nd leg does not reach the end of the 3rd outer marginal spine of the same joint, whereas, in *E. californica* it reaches the end of the 3rd outer marginal spine. The 5th pair of leg of the male are characterised by the shape of the distal joint of the exopodite of the left leg. This is the same species which I reported in the list of species under the name *P. nitida* sp. nov. in 1953.

Occurrence. 50 females and 6 males in 18 hauls from the depth 1000–0 m in Sagami, and 1 female and 2 males from the depth 1260–0, in Suruga Bay, December 1937.

Distribution. The species has been reported from the Far-Eastern and Polar Seas.

Pareuchaeta hanseni WITH

(Fig. 78, *a–h*)

Euchaeta hanseni, WITH, 1915, p. 181; *Pareuchaeta hanseni*, SARS, 1925, p. 115; JESPERSEN, 1934, p. 80; SEWELL, 1947, p. 121; WILSON, 1950, p. 282.

Female. Length, 8.7 mm. The cephalothorax, 6.2 mm, the abdomen, 2.5 mm; so the abdomen is contained 2.5 times in the length of the cephalothorax. The lateral corner of the last thoracic segment rounded and furnished with a tuft of rather poor hairs. The rostrum moderate, directs forwards; the frontal prominence low.

The first three abdominal segments in 0.01 mm are 106 : 56 : 56. The genital protuberance deep; the lateral flanges of the genital opening projects posteriorly. The ventral surface of the 2nd and 3rd segments very setose. The anal segment short, with short hairs on the ventral surface. The furca about 1.4 times as long as wide; the 2nd furcal seta about 2.5 times as long as the remaining ones; the appendicular seta slender and long.

The 1st antenna extends to the end of the last thoracic segment; the joints are in the proportional lengths:

Joint	1	2	3	4	5	6	7	8–9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24–25	
	40	46	21	21	21	24	24	31	13	18	25	40	40	49	58	61	64	76	70	67	58	55	73	=1000.

The outer lobe of the 1st maxilla has 7 long and 2 short slender setae. The other mouth parts as in *E. barbata.*

The exopodite of the 1st leg has moderately long spine at the bootom of the concavity. In the exopodite of the 2nd leg the outer edge spine of the 2nd joint reaches the base of the proximal spine of the 3rd joint; the 2nd spine of the 3rd joint reaches about the base of the 3rd spine of the same joint.

Male. Length, 8.27 mm. The cephalothorax, 5.70 mm; the abdomen, 2.57 mm. The rostrum long and slender; the frontal prominence low. The 1st abdominal segment has a dorsal process on the anterior border. The marginal furcal setae as long as the combined lengths of the last 4 abdominal segments and the furca; the 2nd seta 1.5 times, the appendicular seta half the length of the remaining ones.

The 1st antenna extends beyond the end of the last thoracic segment by last 2 joints; the 20th joint has an aesthetask.

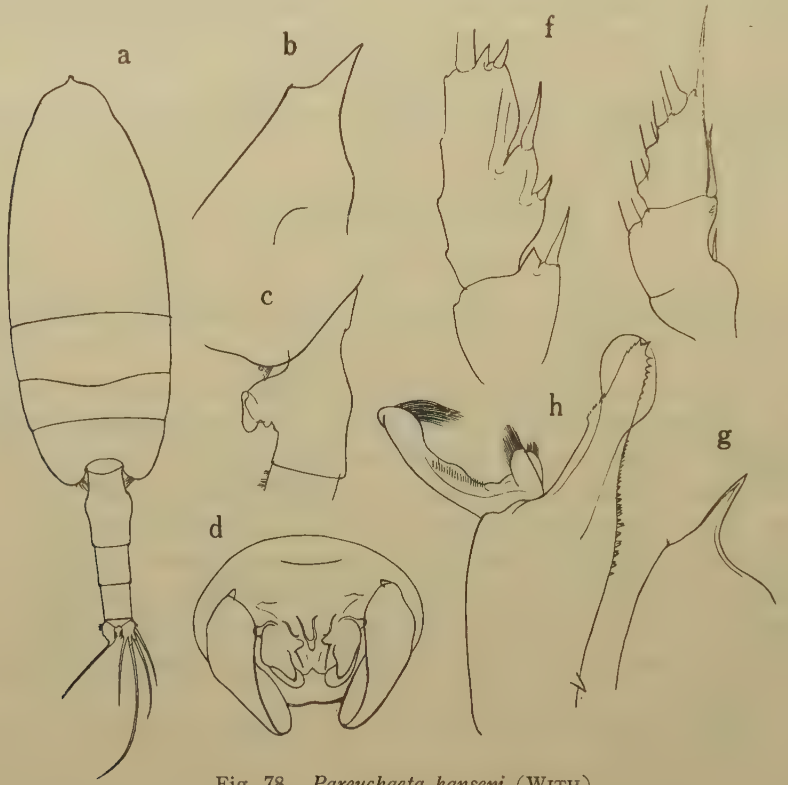

Fig. 78. *Pareuchaeta hanseni* (WITH).
Female: *a*, dorsal aspect; *b*, head, lateral aspect; *c*, last thoracic segment and abdominal segment, lateral aspect; *d*, genital opening, ventral aspect; *e*, exopodite of 1st leg; *f*, exopodite of 2nd leg. Male: *g*, head, lateral aspect; *h*, terminal joints of left 5th leg.

The 1st joint of the exopodite of the right 5th leg has a spine on the outer margin. The distal joint of the exopodite of the left leg as shown in the firgure.

Occurrence. 2 females and 3 males from Sagami in the vertical hauls 1000–0 m, November 1937.

Distribution. The species has been recorded from the North Atlantic, the Arabian Sea, and also from the Pacific.

Pareuchaeta comosa sp. nov.

(Fig. 79, *a–j*)

Female. Length, 8.8–9.3 mm. The proportional lengths of the cephalothorax and abdomen in mid-dorsal line is 66 to 25, so the abdomen is contained 2.6 times in the length of the cephalothorax. The lateral corner of the last thoracic segment rounded and furnished with usual tufts of hairs. The head contracts anteriorly. The rostrum slender, directs straight forwards; the frontal prominence low.

The proportional lengths of the first 3 abdominal segments are 19 : 9 : 8. The genital segment has a small dorso-lateral process near the anterior border on the left side; the genital boss is not deep; the lateral flanges produced posteriorly, and is convex at the middle portion. The posterior margins of the 2nd and 3rd segments are fringed with fine teeth on the dorsal; the ventral surface of the 3rd segment is setose. The proportional lengths of the 2nd, appendicular and remaining furcal setae are 3 : 7 : 1.

The 1st antenna extends beyond the end of the last thoracic segment by distal one joint when fully reflexed; the joints are in the following proportional lengths:

Joint	1	2	3	4	5	6	7	8–9	10	11	12	13	14	
	33	41	23	20	25	25	25	35	23	30	30	43	41	
	15	16	17	18	19	20	21	22	23	24–25				
	53	61	61	61	68	64	61	58	51	68	=1000;			

the 17th joint is as long as the 21st; the 19th as long as the 24–25th.

The mouth parts as in *P. sarsi.* The outer lobe of the 1st maxilla has 6 long and 1 short setae.

In the 1st leg the articular membrane between the 1st and 2nd joints of the exopodite well marked; there is a group of short hairs at the base of the minute outer edge spine arising from the bottom of the concavity; the distal margin of the joints 1–2 is furnished with 2 groups of short hairs; the outer margin of the 3rd joint is not smooth but has a small swelling about the proximal 1/3 of the joint; the outer margin of the same joint has 2 groups of short hairs, one at the proximal, and the another on the swelling. In the exopodite of the 2nd leg the outer edge spine of the 2nd joint reaches the base of the proximal spine of the 3rd joint; the 2nd spine of the 3rd joint of exopodite does not reach the distal margin of the joint; the sinus at the base of the 2nd spine is very deep that it reaches well to the line drawn between the base of the proximal outer dege spine and the 1st proximal inner marginal seta; there are fairly long hairs at the inner proximal margin of the 2nd outer marginal spine of the 3rd joint of exopodite. The outer margin of the 3rd joint of the exopodite of the 3rd leg as shown in the figure.

Male. Length, 7.25 mm. The cephalothorax, 4.81 mm, the abdomen, 2.44 mm; so the abdomen is contained 1.98 times in the length of the cephalothorax. The lateral corner of the last thoracic segment rounded, and produced more on the left side. The rostrum is long and straight but directs slightly downwards; the frontal prominence low.

The proportional lengths of the abdominal segments and the furca are 28 : 36 : 34 : 25 : 6 : 10 = 100. The 1st segment has a dorsal process near the anterior border. The 2nd, 3rd, and 4th segments have each coarse teeth on the distal margin. The 2nd furcal seta 1.5 times, the appendicular seta about half the length of the remaining ones.

The 1st antenna extends beyond the end of the last thoracic segment by distal

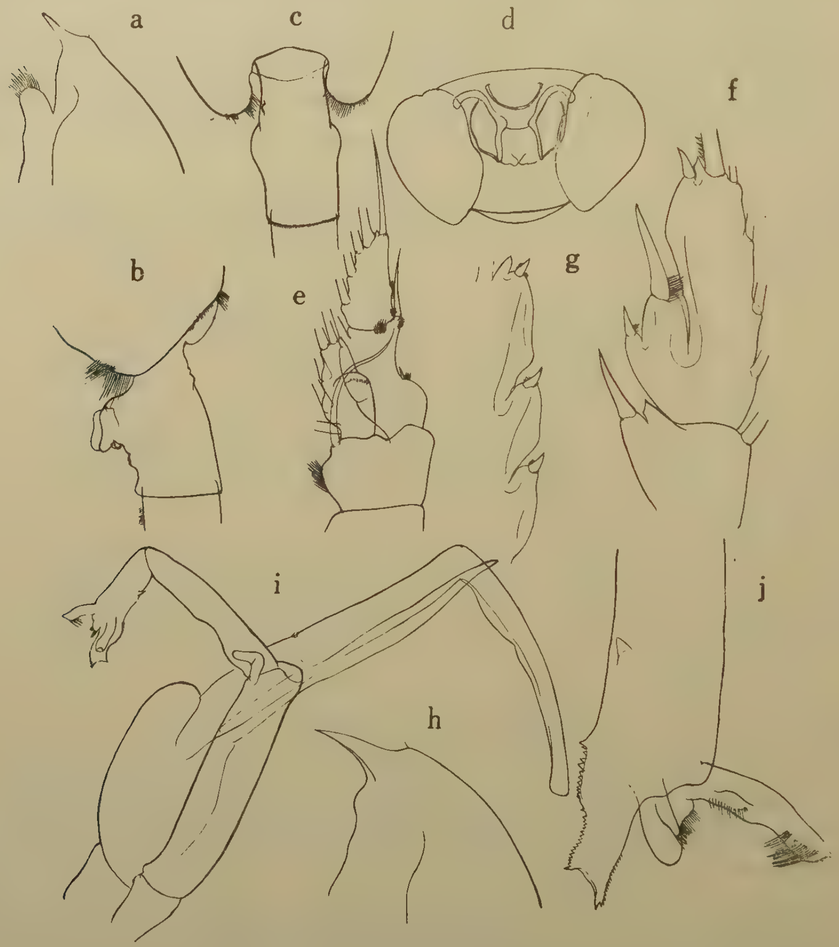

Fig. 79. *Pareuchaeta comosa* sp. nov.
Female: *a*, head, lateral aspect; *b*, last thoracic segment and genital segment, lateral aspect; *c*, last thoracic segment and genital segment, dorsal aspect; *d*, genital opening, ventral aspect; *e*, 1st leg; *f*, exopodite of 2nd leg; *g*, outer margin of 3rd joint of exopodite of 3rd leg. Male: *h*, head, lateral aspect; *i*, 5th pair of legs; *j*, terminal joints of left 5th leg.

one joint; the joints are in the proportional lengths:

Joint	1	2	3	4	5	6	7	8–9–10	11	12–13	14
	38	32	19	19	26	26	29	69	22	64	38

15	16	17	18	19	20	21	22	23	24–25	
48	58	58	61	71	71	64	61	55	71	=1000;

the 19th is as long as the 24–25th; the 24–25 is 1.3 times as long as the 23rd; no aesthetask on the 20th. The mouth parts do not show any characteristic features.

In the 1st leg the 1st joint of the exopodite has a very minute outer edge spine. The 2nd leg is not characteristic; the 2nd spine of the 3rd joint of the exopodite reaches about the middle of the 3rd division. In the 5th pair of legs the thumb on the left leg resembles that of *P. dubia* ESTERLY but differs from it in not having dentation on the apical section; in the right leg the 1st joint of the exopodite has a spine on the outer margin.

Remarks. The present species resembles *P. sarsi* (FARRAN) but can be recognised by the shape of the genital segment, the slender rostrum, the number of setae on the outer lobe of the 1st maxilla, and the structure of the 1st and 2nd legs of the female.

Occurrence. 2 females and one male in the vertical haul from 1260–0 m, December 1937, and 4 females in the vertical hauls from 1000–0 m, November 1937 in Suruga Bay; 4 females in the vertical hauls from 1000–0 m., November 1937, and 2 females in the vertical hauls from 1000–0 m, April 1938 in Sagami Bay.

Pareuchaeta tonsa (GIESBRECHT)

(Fig. 80, *a–i*)

Euchaeta tonsa, GIESBRECHT, 1898, p. 40; FARRAN, 1905, p. 35; ESTERLY, 1906, p. 64; *Pareuchaeta tuberculata*, A. SCOTT, 1909, p. 76 (male): *Euchaeta tonsa*, WITH, 1915, p. 166; *Pareuchaeta tonsa*, SARS, 1925, p. 122; SEWELL, 1947, p. 131; WILSON, 1950, p. 284; BRODSKY, 1950, p. 208.

Female. Length, 6.1–6.7 mm. The abdomen is contained 2.4 times in the length of the cephalothorax. The lateral corner of the last thoracic segment triangular but not so pointed as figured by WITH; there is no tuft of hairs along the lateral corner. The rostrum short, directs forwards. The frontal prominence high.

The first three abdominal segments have the proportional lengths 40 : 24 : 24. The genital segment much inflated on the distal half when viewed from the dorsal; the genital protuberance arises from the distal margin of the segment, and is very prominent. The 2nd and 3rd segments are devoid of hairs on the dorsal surfaces; the ventral surface of the 3rd segment is furnished with groups of hairs. The 2nd furcal seta about 3 times, the appendicular seta about 6 times as long as the remaining ones.

The 1st antenna reaches the end of the 3rd thoracic segment; the joints are in the proportional lengths:

Joint	1	2	3	4	5	6	7	8–9	10	11	12	13	14
	52	48	24	24	26	28	28	54	24	22	28	44	40

15	16	17	18	19	20	21	22	23	24–25	
44	56	56	60	72	68	60	52	46	64	=1000;

the 17th joint is shorter than the 21st; the 24–25th shorter than the 19th. The outer lobe of the 1st maxilla bears 7 long and 2 short setae.

In the 1st leg the articulation between the 1st and the 2nd joints of the exopodite obscure; there is a minute spine at the base of the concavity. In the 2nd leg the outer edge spine of the 2nd joint of the exopodite exceeds the base of the proximal spine of the 3rd joint; the 2nd outer edge spine of the 3rd joint reaches the distal margin of the joint; this agrees well with the description given by WITH, but according to A. SCOTT the spine does not reach the distal margin of the 3rd joint.

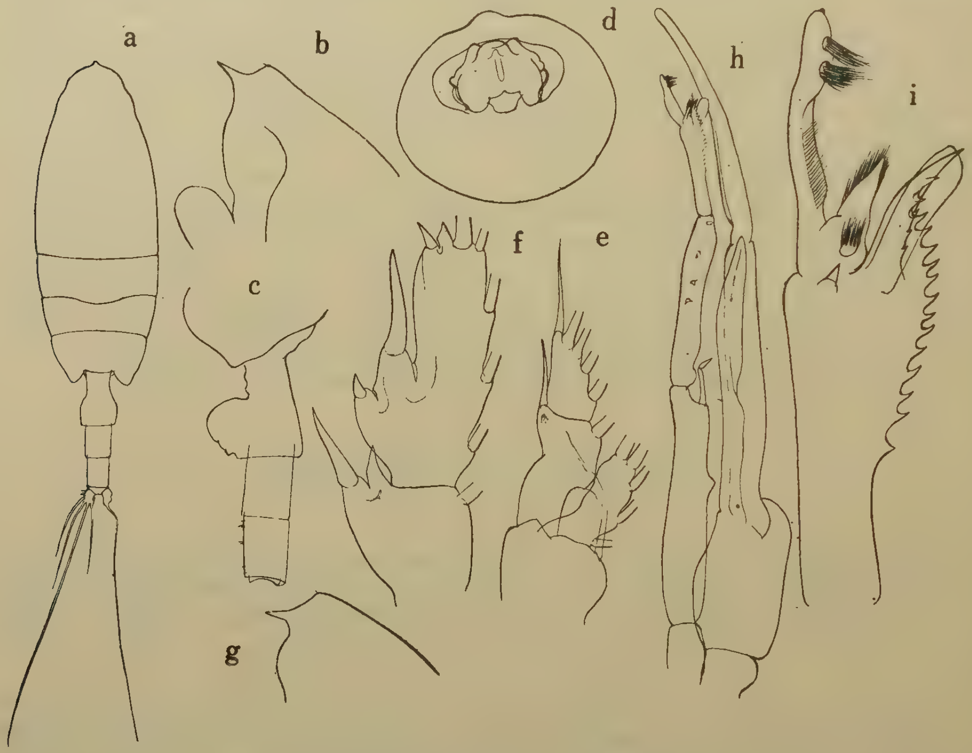

Fig. 80. *Pareuchaeta tonsa* (GIESBRECHT).
Female: *a*, dorsal aspect; *b*, head, lateral aspect; *c*, last thoracic segment and abdominal segments, lateral aspect; *d*, genital opening, ventral aspect; *e*, 1st leg; *f*, exopodite of 2nd leg. Male: *g*, head, lateral aspect; *h*, 5th pair of legs; *i*, terminal joints of left 5th leg.

Male. Length, 5.43–5.88 mm. The abdomen is contained about 2.2 times in the length of the cephalothorax. The lateral corner of the last thoracic segment more produced on the left side than on the right. The frontal prominence high. The rostrum short, directs forwards and downwards. The proportional lengths of the abdominal segments and the furca are 23 : 27 : 24 :14 : 5 : 7 = 100. The genital segment has a dorsal process near the anterior border. The 2nd, 3rd, and 4th segments are fringed with coarse teeth on the posterior margin. The 2nd furcal seta about 1.5 times the length of the marginal ones, the appendicular seta very slender but a little shorter than the 2nd seta.

The 1st antenna extends beyond the end of the cephalothorax by last one joint; the proportional lengths of the joints are as follows:

Joint	1	2	3	4	5	6	7	8–9–10	11	12–13	14	15	16	17	18	19	20	21	22	23	24–25	
	48	36	20	20	26	31	36	72	28	32	40	48	56	59	59	76	76	63	59	52	63	=1000;

the 19th joint is longer than the 24–25th. The mouth parts are somewhat reduced.

The 1st leg with 3–jointed exopodite and 1–jointed endopodite; the 1st joint of the exopodite has a minute outer edge spine. In the 2nd leg the outer edge spine of the 2nd joint of the exopodite is short, reaching about the middle of the 1st division of the 3rd joint of the exopodite; the 2nd spine of the 3rd joint is the longest and exceeds the middle of the 3rd division.

The 5th pair of legs resemble quite well with those of *E. norvegica* (Boeck). In the left leg the thumb on the distal joint of the exopodite has the denticles more regularly arranged that in *E. norvegica*; there is a short pointed process on the distal outer margin near the junction with the 3rd joint; the haired middle process at the base of the 3rd joint of the exopodite is long and spiniform; the 1st joint of the exopodite of the left leg has 2 tubercles on the middle of the outer margin, and a small spine midway between the distal tubercle and the distal margin of the same joint. The exopodite of the right leg 2–jointed and elongate.

Remarks. Absence of the male specimen of *P. tonsa* in the "Siboga" collection seems to be very strange. *P. tuberculata* descirbed and figured by A. Scott, though larger in size (6.8 mm), appears to be the male of *P. tonsa.* The Pacific specimen differs in some minute points from those of the Atlantic.

Occurrence. One of the most common species in the deep waters of the Izu region.

Distribution. The species is widely distributed in the deep waters of the Atlantic, Indian, and Pacific Oceans. The species has also been recorded from the Sea of Japan, and Ochotsk sea.

STUDIES ON THE HELMINTH FAUNA OF JAPAN

PART 52. TREMATODES OF FISHES, XI

SATYU YAMAGUTI

Department of Parasitology, Okayama University Medical School, Okayama

With Plates XIV–XV

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AEROBIOTREMATIDAE n. fam.

1. *Aerobiotrema muraenesocis* n. g., n. sp.

(Pl. XIV, Figs. 4–6; Pl. XV, Fig. 10)

Habitat: Air-bladder of *Muraenesox cinereus*.

Material and locality: Two mature specimens; Tamano Aquarium at Shibukawa, Tamano City, Okayama Prefecture.

Publ. Seto Mar. Biol. Lab., VI (3), 1958. (Article 19)

Body plump 13.5 mm long[1], rounded at two extremities ; the hemispherical posterior region covered with smooth cuticle is delimited from the main body by a distinct circular ridge as shown in the free-hand sketch (Fig. 10). Forebody tapered anteriorly and curved a little ventrally ; cuticle thick, transversely wrinkled ventrally, especially at the acetabular level. Between the genital pore and the acetabulum is a transversely elongated shallow depression clearly recognizable with a hand lens. On the sectioned preparations the body parenchyma consists of an outer layer of comparatively fine network of connective fibrils and an inner layer of spongy network of coarser fibrils, the open spaces of which contain very fine granules precipitated by SCHAUDINN's fixative with glacial acid added. The oral and ventral suckers, pharynx, esophagus, terminal genitalia and peripheral uterine coils are embedded in the dense peripheral layer, while the other reproductive organs, intestinal ceca and excretory vesicle occupy the spongy central parenchyma.

Oral sucker spherical, 1.7–2.1 mm in diameter, subterminal, with overhanging preoral lip formed by body wall, directly followed by muscular pharynx 0.9 mm long by 0.96 mm broad. Esophagus constricted at very beginning, but greatly expanded elsewhere, directed posterodorsally and then turning ventrad to bifurcate behind pharynx. Ceca very wide throughout their length, with sinuous walls, forming an abrupt turn in front of testes, and encircling the latter, behind which they form another acute turn to encircle the ovarian complex, finally terminating blindly at posterior extremity near dorsal cuticle. Acetabulum spherical, embedded in body parenchyma about one-third of body length from anterior extremity.

Testes rounded rectangular in lateral view, 3.3 mm in greatest dorsoventral diameter, lying in direct contact with each other behind level of acetabulum between two ceca, surrounded dorsally by uterine coils, each giving off its own vas efferens from near anterodorsal corner. Two vasa efferentia running forward convergently, uniting to form elongate sigmoid vesicula seminalis, which is wider distally than proximally, attaining maximum width of 0.4 mm. Pars prostatica 0.7 mm long, widest (0.25 mm) at base, surrounded by flask-shaped compact mass of gland cells, situated dorsoventrally about midway between pharynx and acetabulum, followed by comparatively short (0.4 mm long) ejaculatory duct which is lined with thick smooth cuticle and opens along with the metraterm into the ductus hermaphroditicus. The latter, appearing as a direct continuation of the metraterm, is 0.7 mm long by 0.15 mm wide and opens outside in the median line a little behind the mouth aperture.

Ovary small, ovoid, 0.8×0.4 mm, situated about middle of posterior portion demarcated from main body, left of shell gland, with long axis dorsoventral. Shell gland large, enclosed in fibrous capsule in front of distal end of ceca ; ootype large, surrounded by radiating gland ducts ; receptaculum seminis and Laurer's canal absent. The uterine duct, winding in the spongy parenchyma on the left of the ovary, proceeds toward the periphery; after forming a transverse coil on the right of the ovarian complex the uterus turns back to the left side and extends longitudinally, occupying the whole ventral area between the posterior extremity and the testes, then running dorsad behind the testes forms two longitudinal loops on the dorsal side of the testes and ceca. Finally it comes to lie in front of the testes, where the terminal uterus passes between the two vasa efferentia and leads into the metraterm beside the pars prostatica. Metraterm 1.0 mm long, lined with thick smooth cuticle and provided with inner circular and outer longitudinal muscles. Eggs round, embryonated, 16–18 μ in diameter. Vitellaria divided into bunches of large rounded follicles, extending longitudinally on each side of ovarian complex, between the latter and ceca, as well as in intercecal field just posterior to testes.

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[1] Unless otherwise stated, all measurements are from specimens subjected to coverglass pressure when fixed with SCHAUDINN's solution.

Excretory vesicle Y-shaped in general pattern; the stem originating from the terminal pore ascends in the central region, then on the left of the ovarina complex, and bifurcates at the level of the anterior end of the vitellaria; two arms apparently uniting dorsal to pharynx, sending off numerous, long or short, partly anastomosing, side branches, most of which lie close to the ceca medial, ventral, or lateral to them.

This genus is characterized by the main body being demarcated from the hemispherical posterior extremity by a circular ridge, and by the vitellaria forming grape-like bunches of large follicles and being confined to the post-testicular intercecal field, and by the Y-shaped excretory arms being provided with numerous side branches running parallel to the winding ceca. In view of these characteristics it undoubtedly represents a distinct family, though resembling *Isoparorchis* SOUTHWELL, 1913, in gross internal anatomy and habitat.

The new family, for which Aerobiotrematidae is proposed, is defined as follows and placed near the Isoparorchiidae.

AEROBIOTREMATIDAE n. fam.

Family diagnosis.—Digenea with ventral acetabulum. Body robust, plump, with posterior region marked off from main body by circular ridge. Body parencyma divided into dense peripheral layer and spongy central layer. Oral sucker and pharynx well developed, ceca sinuous. Acetabulum near anterior extremity. Testes juxtaposed, postacetabular. Vesicula seminalis and prostatic complex strongly developed, hermaphroditic duct present. Genital pore median between two suckers. Ovary compact, near posterior extremity. No Laurer's canal. Vitellaria forming grapelike bunches of large follicles, extending in posttesticular field. Uterus strongly distended with eggs, occupying all available space posterior, dorsal and anterior to testes; metraterm well differentiated. Excretory vesicle Y-shaped in general pattern, with arms uniting anteriorly and provided with numerous side branches running parallel to ceca. Parasitic in air bladder of fishes.

Type genus: *Aerobiotrema*[1] n. g.

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[1] Refers to the habitat.

Aerobiotrema n. g.

Generic diagnosis.—Aerobiotrematidae: With characters of family. Oral sucker subterminal, directly followed by pharynx, esophagus turned back on itself; ceca very wide, with sinuous walls, terminating blindly at posterior extremity. Acetabulum smaller than oral sucker, nearly one third of body length from anterior extremity, not prominent over ventral surface. Testes voluminous, juxtaposed behind acetabulum; seminal vesicle elongate, winding behind intestinal bifurcation; pars prostatica surrounded by dense mass of prostate cells; ductus ejaculatorius joining metraterm to form hermaphroditic duct. No cirrus pouch. Genital pore about halfway between two suckers. Ovary situated beside shell gland near posterior extremity. Neither receptaculum seminis nor Laurer's canal. Uterus strongly distended with eggs, winding posterior, dorsal and anterior to testes; metraterm in direct continuation of hermaphroditic duct; eggs small, round, embryonated. Excretory vesicle Y-shaped; arms with numerous side branches, uniting dorsal to pharynx. Parasitic in air bladder of teleosts.

Genotype: *A. muraenesocis* n. sp.

ALLOCREADIIDAE STOSSICH, 1903

2. *Helicometra epinepheli* YAMAGUTI, 1934

Ten mature specimens, collected from the small intestine of *Epinephelus akaara* on September 8 at Sibukawa, Okayama Prefecture, gave under cover glass pressure the following measurements in mm, which will serve to extend the range of variations given in my original description.

Body 1.5–3.5×0.5–1.1; oral sucker 0.14–0.19 in diameter, prepharynx 0.03–0.06; pharynx 0.06–0.13×0.05–0.09; esophagus 0.11–0.2 long; acetabulum 0.2–0.25 in diameter; testes 0.12–0.42×0.3–0.61; cirrus pouch 0.3–0.6×0.05–0.1; ovary 0.1–0.25×0.25–0.36; receptaculum seminis 0.07–0.13 wide; eggs 47–54×27–30 μ.

3. *Opecoelus lateolabracis* n. sp.

(Pl. XIV, Fig. 3)

Habitat: Small intestine of *Lateolabrax japonicus.*

Material, locality and date: Four gravid specimens; Inland Sea; Sept. 7, 1957.

Body slender, 1.6–2.3 mm long by 0.14–0.22 mm broad, covered with thin smooth cuticle; forebody tapering anteriorly, hindbody cylindrical, with uniform width of 0.14–0.22 mm, rounded at posterior extremity. Oral sucker terminal, 54–58×47–70 μ, with subterminal aperture; prepharynx 10–56 μ long, pharynx barrel-shaped, 31–44 ×26–40 μ; esophagus 0.065–0.14 mm long, bifurcating just anterior to base of acetabulum. Ceca narrow, united posteriorly and opening ventroterminally. Acetabulum projecting prominently, 0.11–0.156 mm in diameter, situated close to anterior extremity, with 6, sharp-pointed, solid, horn-like, marginal projections, 3 on anterior margin and 3 on posterior margin.

Testes oval, 0.11–0.15×0.07–0.11 mm, separated one from the other by vitellaria, situated in middle third of body or a little more posteriorly. Seminal vesicle elongated claviform, with maximum width of 33–56 μ, extending posterior to acetabulum. Prostatic cells reduced around attenuated distal portion of seminal vesicle. Cirrus pouch slender, subcylindrical, 78 μ by 15.6 μ wide in the type, reaching as far backward as level of anterior end of acetabulum, enclosing small oval pars prostatica at its base. Genital pore to left of median line just in front of intestinal bifurcation.

Ovary reniform or trilobate, with concavity in front, 23–44 μ by 78–114 μ, situated transversely in front of anterior testis, from which it is separated by vitellaria. No receptaculum seminis, Laurer's canal opening dorsally posterosinistral to ovary. Uterus winding between preovarian shell gland and base of seminal vesicle, whence it takes a straight ascending course along with seminal vesicle. Eggs oval, 62–65 μ in diameter in whole mounts, comparatively few in number. Vitellaria extending in lateral fields between level of posterior end of seminal vesicle and posterior extremity, confluent in posttesticular area. Excretory vesicle simple, tubular, with terminal pore.

This species differs from the most closely related *O. sebastodis* YAMAGUTI, 1934, in the marginal appendages of the acetabulum being sharp-pointed, the seminal vesicle not being bipartite, and the opening of the Laurer's canal being submedian instead of median; the eggs are 75–92 μ long by 45–63 μ broad in *sebastodis*, but 62–65 μ long by 41–43 μ broad in the present species.

4. *Opecoelus sebastisci* n. sp.

(Pl. XV, Fig. 11)

Habitat: Small intestine of *Sebastiscus marmoratus*.

Material and locality: One gravid specimen (April 30, 1957) and three gravid specimens (Sept. 9, 1957); Inland Sea.

Body subcylindrical to fusiform, flattened, blunt-pointed at extremities, unarmed, 1.75–3.5 mm long by 0.3–0.58 mm broad. Oral sucker spherical, 0.1–0.14 mm in diameter, with ventroterminal aperture. Prepharynx distinct, pharynx barrel-shaped, 70–83×41–80 μ; esophagus short, 0.065–0.12 mm long, lined with cuticle throughout its length, bifurcating in front of base of acetabulum; ceca united posteriorly and opening ventrally at posterior extremity. Acetabulum short-stalked, 0.14–0.21 mm in diameter, at about middle of anterior third of body, with six blunt digitiform marginal appendages.

Testes subglobular, more or less indented, 0.11–0.28×0.2–0.41 mm; anterior testis equatorial or postequatorial, separated by vitellaria from posterior testis as well as from ovary. Vesicula seminalis winding, with maximum width of 52–70 μ at its cylindrical posterior portion; prostatic cells surrounding attenuated distal portion of seminal vesicle. Small oval pars prostatica and proximally winding cirrus enclosed in club- or retort-shaped cirrus pouch 0.12–0.2 mm long by 39–50 μ wide. Genital pore on the left of esophagus.

Ovary coarsely trilobate, transversely elongated, 0.065–0.14 mm long by 0.2–0.32 mm wide, pre-equatorial, nearly median; germiduct sinuous, giving off Laurer's canal in front of ovary, and uniting with vitelline duct anteromedial to vitelline reservoir. Laurer's canal originating from germiduct in front of ovary, describing a loop and opening dorsal to ovary immediately posterior or posteromedial to vitelline reservoir. Uterus convoluted in intercecal field between shell gland and level of posterior portion of seminal vesicle, and then running straight forward; metraterm well differentiated, crossing cirrus pouch dorsally; eggs oval, 56–65×30–35 μ in life. Vitellaria occupying lateral fields between level of posterior end of seminal vesicle and posterior extremity, confluent in posttesticular region. Excretory vesicle tubular, reaching to ovary; pore terminal.

This species resembles *Opecoelus nipponicus* YAMAGUTI, 1951, in general body shape, but differs from it in the length of the cirrus pouch. That the Laurer's canal opens dorsal to the ovary behind the vitelline reservoir is also worth noting.

5. *Opecoelus pagrosomi* n. sp.

(Pl. XV, Fig. 12)

Habitat: Small intestine of *Pagrosomus unicolor*.

Material, locality and date: 3 gravid specimens; Inland Sea; Sept. 7, 1957.

Body lanceolate 1.65–1.7 mm long by 0.48–0.52 mm wide, unarmed. Oral sucker subterminal, spherical, about 0.14 mm in diameter; prepharynx 30–40 μ long, pharynx barrel-shaped, 70–80×60–65 μ. Esophagus 80–100 μ long; ceca united posteriorly and opening ventrally about 70 μ from posterior tip of body in the type. Acetabulum 0.2 mm in diameter, with six conical marginal appendages interlocking with one another, situated at junction of anterior with middle third of body.

Testes irregularly lobed or indented, wider than long, 0.11–0.18×0.26–0.3 mm, directly tandem, posterior one at junction of middle with posterior third of body. Seminal vesicle usually not reaching backward beyond acetabulum, consisting of a cylindrical proximal portion 50–80 μ wide and a much narrower, winding, distal portion surrounded by prostatic cells. Cirrus pouch claviform, 90–100×30–50 μ, with thick wall of inner circular and outer longitudinal muscle fibers, situated obliquely with its base ventral to left cecum, enclosing ovoid pars prostatica and proximally winding cirrus. Genital pore sinistral to esophagus.

Ovary transversely elongated, concave in front, indented behind or not, median or slightly to right of median line, equatorial or postequatorial, 60–90 μ by 0.2–0.24 mm; germiduct tortuous, giving off Laurer's canal at the point, where it turns back toward the left just anterior to the right end of the ovary. Laurer's canal crossing transversely dorsal to the vitelline reservoir and forms a complete loop just before opening dorsally in front of the left portion of the ovary. Receptaculum seminis uterinum present. Uterine coils confined to intercecal field between ovary and acetabulum; metraterm short, along the left side of cirrus pouch; eggs oval, 56–65×32–39 μ in life. Vitellaria commencing at level of acetabulum or a little in front of it, occupying whole lateral field of hindbody as well as posttesticular region; vitelline reservoir anterodorsal to ovary. Excretory vesicle tubular, median, reaching to ovary; pore terminal.

This species resembles *O. xenistii* MANTER, 1940, very closely, but differs from it in egg size; in MANTER's species the eggs are 50–59 μ by 29–34 μ. Since no mention is made about the size of the cirrus pouch and the position of the aperture of the Laurer's canal in *O. xenistii*, a further comparison is not possible.

6. *Opegaster cryptocentri* n. sp.

(Pl. XIV, Fig. 2)

Habitat: Small intestine of *Cryptocentrus filifer*.

Material: A single gravid specimen stained and mounted *in toto*.

Locality and date: Inland Sea; September 9, 1957.

Body flattened fusiform, with rounded ends, 1.6×0.56 mm, widest at level of midbody. Cuticle smooth. In the shoulder region there is on each side a group of unicellular gland cells containing fine secretory granules. Oral sucker terminal, with ventral aperture, 0.18×0.15 mm; prepharynx expanded, with circular and longitudinal muscles; pharynx muscular, 0.1×0.16 mm; esophagus about 0.1 mm long, lined with thik cuticle, with muscular wall; ceca very wide throughout, united posteriorly and opening ventrally very close to posterior end of body. Acetabulum 0.21×0.24 mm, with a transverse row of seven papillae along anterior and posterior margins respectively, situated at third sixth of body; its lateral ends projecting only slightly.

Testes transversely elongated, with a shallow notch on posterior border, directly tandem, at about middle of hindbody; anterior testis 0.1×0.2 mm, at junction of middle with posterior third of body; posterior testis 0.13×0.2 mm. Seminal vesicle retort-shaped, 0.1 mm in diameter, with its expanded portion confined to median field between intestinal bifurcation and acetabulum, and its tapering anterior portion crossing commencement of left cecum ventrally; prostate cells around this portion markedly reduced. Cirrus pouch fusiform, 0.12 mm long, with maximum width of 20 μ at level of pars prostatica which is oval and measures only 16 μ long by 10 μ wide; cirrus (or ejaculatory duct) 36 μ by 4.5 μ, lined with smooth cuticle. Genital pore just to left of esophagus.

Ovary transversely elongated bean-shaped, 0.07×0.2 mm, immediately in front of anterior testis, slightly to right. The germiduct, originating from the ventral surface of the ovary near its anterodextral corner, follows a sinuous transverse course toward the right, and turns back on itself in front of the right end of the vitelline reservoir, and then unites with the vitelline duct coming from behind; the ootype lies immediately in front of the ovary to the left of the vitelline reservoir. Uterus coiled between ovary and acetabulum and on the left of the latter; metraterm not appreciably differentiated; eggs oval, 63–73×34–39 μ in life. Vitelline follicles extending in lateral fields of fore- and hindbody, commencing at level of posterior end of esophagus and occupying whole posttesticular median field; vitelline reservoir oval, 0.05×0.1 mm, anterodorsal to right portion of ovary, giving off its efferent duct at its left end.

Excretory vesicle tubular, reaching to dorsal side of ovary; pore terminal.

This species differs from the most closely related *Opegaster beliyai* PANDE, 1937, from *Gobius giuris* and *O. mehrii* HARSHEY, 1937, from *Mastacembelus armatus* in the posterior extent of the seminal vesicle, and from *O. synodi* MANTER, 1947, from *Synodus foetens* in egg size; in MANTER's species the egge are distinctly smaller, measuring 50–54×30–32 μ.

ACANTHOSTOMIDAE POCHE, 1926

7. *Biovarium lateolabracis* n. sp.

(Pl. XV, Fig. 7)

Habitat: Small intestine of *Lateolabrax japonicus*.

Material, locality and date: A single gravid specimen; Inland Sea; Sept. 10, 1957.

Body lanceolate, 1.6 mm long, with maximum width of of 0.34 mm at middle, blunt-pointed at two extremities; cuticle beset all over with very fine spines. Subcuticular dermal gland cells scattered throughout body except for two extremities. Residue of larval eye spots scattered in anterior region of body. Oral sucker spherical, 0.13 mm in diameter, opening ventroterminally. Prepharynx 0.1 mm long; pharynx barrel-shaped, 63×52 μ, with wide lumen; esophagus only 64 μ long; ceca terminating short of posterior extremity, at about middle of posttesticular region. Acetabulum 78×86 μ, embedded in body parenchyma at about midbody.

Testes flattened elliptical, directly tandem; anterior testis 0.2×0.1 mm, at junction of middle with posterior third of body, posterior one 0.3×0.1 mm. Seminal vesicle up to 35 μ wide, winding posterior and dextral to acetabulum; pars prostatica cylindrical, curved in form of letter S, about 25 μ wide; its distal end turns back on itself to be continued into an equally wide cirrus, which opens into the genital atrium ventral to the opening of the metraterm. Genital atrium 28 μ in diameter, covered inside with cuticular projections, opening ventrally immediately anterolateral to acetabulum.

Ovary divided into subsymmetrical groups of lobes of irregular outline, situated ventrally about halfway between acetabulum and anterior testis, each group consisting of three or more lobes overreaching ceca laterally. Receptaculum seminis rounded, about 50 μ in diameter, situated immediately behind acetabulum ventral to postacetabular portion of seminal vesicle, slightly to right of median line, containing yolk cells; its backwardly directed duct and the Laurer's canal join the germiduct at the same point just before the latter turns ventrad. Laurer's canal comparatively wide proximally, narrowed and coiled distally and opening dorsally. Proximal portion of uterus winding in intercecal field between ovary and anterior testis, ventral to ceca on each side of anterior and posterior testes, and in posttesticular region, finally ascending straight in median field ventral to anterior testis and dorsal to medial portion of right lobes of ovary, passing immediately behind seminal receptacle from right to left and then ventral and lateral to proximal portion of seminal vesicle to left side of acetabulum; metraterm 18 μ long, much narrower than uterus proper, opening into genital atrium from anterosinistral side dorsal to cirrus; eggs oval, light brown, 14.5–17.5 × 9.5–10 μ. Vitellaria extending diffusely along ceca from behind intestinal bifurcation to level of anterior part of posterior testis, confluent in intercecal field of forebody; descending vitelline duct just medial to cecum of its own side; ascending duct, however, lateral to cecum of its own side, both meeting mediodorsal to cecum just in front of ovary; transverse ducts uniting behind seminal receptacle; vitelline reservoir opening into germiduct just distal to point of adrupt turn of latter.

Excretory vesicle Y-shaped, bifurcating dorsal to ovary; arms ascending just medial and parallel to ceca and crossing beginning of latter dorsally, terminating one on each side posterolateral to pharynx, where they are markedly dilated in form of a club.

This species differs from *Biovarium cryptocotyle* YAMAGUTI, 1934, from the same host species in more extensive development of the vitellaria in the forebody and in the ovary being divided into two groups of lobes instead of two compact masses; moreover the eggs are definitely smaller in the present species than they are in the genotype. There is no genitoacetabular pocket as observed in *B. cryptocotyle*. The saccular organ indicated as vesicula seminalis in Figure 57 of *Biovarium cryptocotyle* is undoubtedly a seminal receptacle, and my previous account that the pars prostatica and cirrus are lacking is erroneous in view of the present observation made on the HEIDENHAIN's preparation, on which morphological details can be worked out more accurately than on hematoxyline-eosin preparations. With the addition of a second species of the genus the generic diagnosis given in my original description of 1934 as well as that of 1953 and 1958 in Systema Helminthum Part I and Vol. I, respectively, must be emended so far as the genito-acetabular pocket and male terminal genitalia are concerned.

ACANTHOCOLPIDAE LÜHE, 1909

8. Adolescaria of *Stephanostomm pagrosomi* YAMAGUTI, 1939

Habitat: Encysted on inner surface of swim-bladder of *Ditrema temmincki*.

Locality and date: Inland Sea; September 7, 1957.

Large numbers of *Ditrema temmincki* were examined and almost every one of them was found heavily infected with this adolescaria folded upon itself in the cyst. The worm was dissected out of the cyst, and straightened out and fixed under a cover slip.

Body retort-shaped, 1.35–1.7 mm in length, 0.64–0.78 mm in maximum width at level of anterior testis, posterior expanded portion occupied by excretory vesicle. Cuticle spined all over except behind oral sucker, where the spineless area is very narrow dorsally but triangular ventrally. A pair of larval eye-spots in neck region. Oral sucker terminal, saucer-shaped, 0.09–0.11 mm by 0.15–0.16 mm, with two alternating rows of 25–27 spines each; ventral spines 29–34 μ long, without any appreciable size difference in the two rows; dorsal spines, especially aboral ones, are somewhat smaller. Prepharynx 0.2–0.24 mm long, pharynx barrel-shaped, 0.12–0.14 × 0.08–0.11 mm, esophagus only 30–80 μ long, lined with thick cuticle; ceca wide, pressed against body wall by swollen excretory vesicle and terminating blindly close to each other at posterior extremity. Acetabulum 0.22–0.25 mm in transverse diameter, pre-equatorial.

Testes subglobular to oval 0.06–0.18 mm long by 0.1–0.16 mm wide, tandem in posterior third of body ventral to excretory vesicle, anterior vas efferens passing dorsal to ootype, posterior one running along right border of anterior testis, both meeting at posterior end of cirrus pouch. Cirrus pouch long and slender, reaching to near ovary; seminal vesicle cylindrical, about 70 μ long by 25 μ wide, followed by short pars prostatica of nearly the same diameter; ejaculatory duct nearly half as wide as seminal vesicle, winding, surrounded throughout its length by prostate cells, joining metraterm dorsal to acetabulum and forming hermaphroditic duct, which in turn opens midventrally immediately in front of the acetabulum.

Ovary subglobular, 41–56 μ by 62–65 μ, situated anterodorsal to right end of anterior testis; the germiduct arising from the dorsal side of the ovary turns back on itself and gives off the Laurer's canal near its origin, and then unites with the duct from the vitelline reservoir; the ootype lies on the left of the ovary; Laurer's canal opens dorsally in front of the ovary; the initial uterine duct is convoluted anterodorsal to the left end of anterior testis; the distal portion of the uterus commencing at the level of the posterior end of the cirrus pouch is provided with well developed longitudinal muscle fibers and a thick coat of glandular accompanying cells. Vitelline anlagen scattered in cecal and intercecal fields posterior to level of ovary in form of small irregular masses of yolk cells, but not recognizable as such anterior to this level.

Excretory vesicle occupying whole intercecal area from posterior extremity to level of ovary, pushing ceca laterally, testes ventrally and ovary dorsally or anterodorsally.

From marked resemblance in general anatomy, especially in the number of the circumoral spines and the ovarian complx it is almost certain that this adolescaria may be referred to *Stephanostomum pagrosomi* YAMAGUTI, 1939. This assumption is supported by the fact thet *Pagrosomus unicolor*, the definitive host of this trematode, is known to be a voracious fish. The communication between the cecal ends and the excretory vesicle must take place in the definitive host.

CRYPTOGONIMIDAE Ciurea, 1933

9. *Diplopharyngotrema lateolabracis* n. g., n. sp.

(Pl. XV, Fig. 9)

Habitat: Small intestine of *Lateolabrax japonicus.*

Material: 2 mature specimens (type specimen entire, syntype damaged when collected).

Locality and date: Inland Sea; September 10, 1957.

Body slender, subcylindrical, covered with smooth cuticle, 5.6 mm long, 0.52 mm broad at anterior extremity in the type, blunt-pointed at posterior extremity. Oral sucker terminal, funnel-shaped, 0.44–0.48 × 0.47–0.52 mm, with very wide aperture, the ventral margin of which presents a marked triangular median and shallow paired submedian incisions, the margin between the median and submedian incisions projecting forward in form of an obtuse triangular lobe. Prepharynx unusually expanded, 0.6 mm long by 0.37 mm wide, enclosing anterior part of pharynx at its base, with larval eye pigments scattered on each side. Pharynx cylindrical, 0.2–0.22 × 0.17–0.24 mm, divided by a slight transverse constriction into two unequal parts; anterior part with funnel-shaped lumen, provided with very strong outer circular muscle; posterior part weakly muscular, with wide lumen gaping backwardly. Esophagus very wide, 0.15–0.2 mm long, bifurcating a short distance anterior to acetabulum; ceca simple, reaching to near posterior extremity. Acetabulum small, 0.13–0.14 mm in diameter, embedded in parenchyma in second sixth of body.

Testes longitudinally elongated oval, 0.3–0.5 × 0.22–0.3 mm, dorsal, wide apart; anterior equatorial, posterior at anterior end of posterior third of body. Seminal vesicle cylindrical, 50–60 μ wide, winding between acetabulum and seminal receptacle, followed by wide cylindrical muscular pars prostatica. The wide ductus ejaculatorius turns back on itself and opens into the genital atrium at its anterior end. Genital pore median, immediately preacetabular.

Ovary multilobate, 0.13–0.15 × 0.25–0.26 mm, median, in anterior part of middle third of body, overreaching ceca laterally; the germiduct arising from the anterior middle part of the ovary proceeds forward and after joining the seminal receptacle turns back on itself and receives the duct from the vitelline reservoir. Laurer's canal, orginating from receptaculum seminis as a direct backward continuation of the latter, opens dorsally a little out of median line at level of anterior end of ovary. Receptaculum seminis rounded, 0.11–0.21 mm in diameter, tapered posteriorly, situated in front of ovary a little to the right; after joining the germiduct it leads directly into the Laurer's canal. Uterine coils first descending as far as posterior extremity and then ascending, covering testes ventrally and occupying nearly all available space posterior to ovary, finally confined to intercecal field between seminal receptacle and acetabulum, overlapping anterior end of seminal receptacle and seminal vesicle ventrally; metraterm short, narrow, opening into genital atrium at its posterior end; eggs oval, very small, 15–18×8–10 μ as mounted in balsam. Vitellaria follicular, extending in lateral fields from level of pharynx to near posterior testis; transverse vitelline ducts united across posterior end of seminal receptacle or Laurer's canal ventrally. Excretory vesicle obscured by uterine coils.

Although the excretory system was unable to work out, there is no doubt from general anatomy whether this worm belongs to the Cryptogonimide CIUREA, 1933. Apparently it represents a new subfamily, for which the name Diplopharyngotrematinae is suggested, and should be placed near Biovariinae YAMAGUTI, 1957. The generic name refers to the pharynx consisting of two different parts.

DIPLOPHARYNGOTREMATINAE n. subf.

Subfamily diagnosis.—Cryptogonimidae: Body slender. Oral sucker funnel-shaped, prepharynx very wide and long; pharynx consisting of two parts of different structure. Esophagus wide, short; ceca simple, long. Acetabulum small, embedded in parenchyma, in anterior region of body. Testes tandem, in hindbody. Vesicula seminalis long, winding; pars prostatica present. Genital pore preacetabular. Ovary multilobate, single, pretesticular. Receptaculum seminis and Laurer's canal present. Uterus extending as far back as posterior extremity; eggs numerous, small. Vitellaria follicular, lateral, moderately extensive. Excretory vesicle? Intestinal parasites of marine teleosts.

Diplopharyngotrema n. g.

Generic diagnosis.—Diplopharyngotrematinae: Body flattened cylindrical, unarmed, with larval eye pigments scattered in neck region. Oral sucker funnel-shaped, gaping forward. Prepharynx strongly expanded; pharynx consisting of anterior part with funnel-shaped lumen and strong outer circular muscles, and posterior part with backwardly gaping lumen and without strong outer circular muscles. Esophagus short, wide; ceca reaching to near posterior extremity. Acetabulum small, postbifurcal. Testes oval, wide apart, in midregion of hindbody. Seminal vesicle winding spirally behind acetabulum, followed by cylindrical, muscular pars prostatica and winding ductus ejaculatorius. Genital pore immediately preacetabular, median. Ovary irregularly multilobed, overreaching ceca laterally anterior to fore testis. Receptaculum seminis voluminous, preovarian, produced backward into Laurer's canal. Uterine coils extensive, occupying all available space of hindbody; metraterm short, narrow; eggs oval, very small, light brown, operculate at narrower end. Vitellaria extending in lateral field of hindbody and intruding a little into forebody. Excretory vesicle unknown. Parasitic in intestine of marine teleosts.

Genotype: *Diplopharygotrema lateolabracis* n. g., n. sp.

10. *Pseudosiphoderoides hapalogenyos* n. g., n. sp.

(Pl. XIV, Fig. 1)

Habitat: Small intestine of *Hapalogenys* sp.

Material: Three gravid specimens.

Locality and date: Inland Sea; September 10, 1957.

Body plump, broadly rounded in front, gradually tapered toward blunt posterior extremity, 3.15–3.2×1.35–1.5 mm. Cuticle thick, unspined, striated perpendicularly. Oral sucker subterminal, 0.2–0.26×0.3–0.35 mm; prepharynx very short, pharynx 0.18–0.2×0.23–0.27 mm in flattened whole mounts, but longer than wide (0.2×0.15 mm) in a section of unflattened specimen. Esophagus practically absent. Ceca comparatively wide, each terminating blindly at a short, equal or unequal distance (0.55 and 0.7 mm respectively in the type) from posterior extremity. Acetabulum 0.23–0.25×0.24–0.26 mm, muscular, embedded in body parenchyma a little behind intestinal bifurcation, and covered up by a fold of body wall which contains circular muscle fibers and has a large oval opening 0.18–0.26 mm in greater transverse diameter.

Testes rounded, 0.3–0.4 mm in diameter, situated somewhat diagonally dorsal to ceca in anterior part of posterior half of body. Seminal vesicle twisted, largely posterolateral to acetabulum, with maximum width of 0.17–0.2 mm. Pars prostatica well differentiated, about 50 μ in diameter, anterodorsal to acetabulum; short ejaculatory duct opening with uterus into base of pocket enclosing acetabulum; prostatic cells strongly developed in vicinity of pars prostatica, especially on its right side.

Ovary median, ventral, equatorial, divided into numerous claviform lobules; seminal receptacle ovoid, 0.25–0.3 mm in diameter, median or slightly submedian, immediately preovarian. Laurer's canal winding, opening dorsally in right submedian line at level of posterior end of ovary or immediately behind it. Vitellaria forming bunches of follicles in acetabulo-ovarian zone dorsal and lateral to ceca, partly intruding mesad dorsally. Uterus winding ventromedial to testes and coiling backward from side to side, overreaching ceca laterally, and then turning forward near posterior extremity to take a sinuous ascending course on the left half of the body up to the level of the seminal receptacle or seminal vesicle, where it passes to the right ventral to the seminal receptacle and is thrown into convolutions on the ventral side anterior to the right testis; finally returning to the median field it runs forwards ventromedial to the seminal vesicle to open into the above mentioned genito-acetabular pouch. Eggs oval, light to dark brown, 18–21×11–13 μ.

Excretory vesicle Y-shaped, with terminal pore; stem very wide, bifurcating at level of posterior end of ovary; arms also wide, terminating at level of pharynx.

This genus differs from the most closely related *Siphoderoides* MANTER, 1940, in the cuticle not being spined, in the seminal vesicle being tubular and sinuous instead of a large undivided sac, in the testes lying dorsal to the ceca, and in the vitellaria extending largely dorsal and lateral to the ceca, and from *Paracryptogonimus* YAMAGUTI, 1934, in the absence of eye spots, body spines and circumoral spines, though resembling in other respects.

Pseudosiphoderoides n. g.

Generic diagnosis.—Cryptogonimidae, Cryptogoniminae: Body medium-sized, plump, unspined. No circumoral spines. Oral sucker larger than acetabulum, subterminal. Prepharynx very short, pharynx elongate, esophagus practically absent, ceca terminating short of posterior extremity. Acetabulum small, embedded in parenchyma in anterior half of body and covered up by a circular fold of body wall (genito-acetabular pouch). Testes two, subsymmetrical or diagonal, postequatorial, dorsal to ceca. Seminal vesicle tubular, sinuous, largely postacetabular. Prostatic complex well developed. Neither cirrus nor cirrus pouch. Genital pore median, opening into genito-acetabular pouch immediately in front of acetabulum. Ovary median, multilobed, pretesticular, with seminal receptacle immediately in front. Vitellaria follicular, extending largely in acetabulo-ovarian zone lateral and dorsal to ceca. Uterine coils pre- and posttesticular, leaving posterior end of body free; eggs very small. Excretory vesicle Y-shaped. Intestinal parasites of marine teleosts.

Genotype: *P. hapalogenyos* n. sp.

BUCEPHALIDAE Poche, 1907

11. *Prosorhynchus crucibulum japonicum* n. subsp.

(Pl. XV, Fig. 8)

Habitat: Small intestine of *Conger myriaster*.

Material: A single gravid specimen stained and mounted *in toto*.

Locality and date: Inland Sea; September 8, 1957.

Body shaped like a plump rod, swollen at level of testes, about 2 mm long by 0.7 mm wide. Rhynchus wedge-shaped, 0.38×0.28 mm. Pharynx 90 μ in diameter, pre-equatorial. Esophagus 0.15×0.03 mm, intestine 0.2×0.09 mm, directed straight forward, with the blind end a little beyond ovary. Testes oval, 0.2–0.22×0.15–0.16 mm, situated obliquely one on each side of esophagus. Cirrus pouch 0.53 mm long by 0.2 mm broad, containing sigmoid, cylindrical, seminal vesicle 80 μ wide, well developed pars prostatica 0.13 mm wide, and a short cirrus only 80 μ long by 20 μ wide. Genital atrium 0.2 mm in diameter, with wide ventral aperture 0.3 mm from posterior extremity.

Ovary oval, 0.22×0.13 mm, overlapping right testis dorsomedially; shell gland behind right testis. Uterus winding first between right testis and cirrus pouch, then convoluted between left testis and left vitellaria, finally descending on the left of cirrus pouch as far back as beyond genital pore, where it turns forward to open into the genital atrium; eggs oval, 26–28 μ long by 20–21 μ broad. Vitelline follicles forming symmetrical groups of 12 and 14 each in shoulder region between rhynchus and testes.

Excretory vesicle tubular, extending on the right of cirrus pouch as far forward as anterior end of cirrus pouch; pore terminal.

This species resembles *Prosorhynchus crucibulum* (RUD.) of NICOLL, 1910, or of OZAKI, 1924, very closely, but differs from it in the shell gland being situated behind the right testis at the level of the pharynx; in OZAKI's specimen the shell gland lies between the ovary and the right testis. The relative position of the testes, ovary and pharynx is subject to great individual variation in the known members of the genus, so that much importance cannot be ascribed to differences in this respect. If the shell gland be also variable in position individually, the present specimen should be referred to *P. crucibulum*, but the contrary seems to be true so far as my experience goes. I would like, therefore, to assign it for the present to a new subspecies, for which the name *Prosorhynchus crucibulum japonicum* is proposed.

Acknowledgements

I wish to express my sincere appreciation to Mr. S. ÔBA, Assistant Professor of the Marine Biological Laboratory of Okayama University, for his help in collecting and identifying the host fishes, and also to the Oceanographical Museum of Tamano City, Okayama Prefecture, for the generous supply of the fishes which died in the aquarium of the museum.

LITERATURE

MANTER, H. W. 1940. Digenetic trematodes of fishes from the Galapagos Islands and the neighboring Pacific. Rep. Allan Hancock Pacif. Exped. (1932–1938) 2 (14), 325–497.

——— 1947. The digenetic trematodes of marine fishes of Tortugas, Florida. Amer. Midl. Nat. 38 (2), 257–416.

YAMAGUTI, S. 1934. Studies on the helminth fauna of Japan. Pt. 2. Trematodes of fishes, I. Jap. J. Zool. 5 (3), 249–541.

——— 1934. Studies on the helminth fauna of Japan. Pt. 26. Trematodes of fishes, VI. Jap. J. Zool. 8 (2), 211–230.

——— 1951. Studies on the helminth fauna of Japan. Pt. 48. Trematodes of fishes, X. Arb. Med. Fak. Okayama 7 (4), 315–334.

——— 1952. Parasitic worms mainly from Celebes. Pt. 1. New digenetic trematodes of fishes. Acta Med. Okayama 8 (2), 146–198.

——— 1953. Systema helminthum. Part I. Digenetic trematodes of fishes. Tokyo.

——— 1958. Systema helminthum. Vol. I. The digenetic trematodes of vertebrates. Interscience, New York.

EXPLANATION OF PLATES XIV–XV

PLATE XIV

Fig. 1. *Pseudosiphoderoides hapalogenyos* n. g., n. sp., ventral view.

Fig. 2. *Opegaster cryptocentri* n. sp., ventral view.

Fig. 3. *Opecoelus lateolabracis* n. sp.; forebody in lateral view, hindbody in ventral view.

Fig. 4. *Aerobiotrema muraenesocis* n. g., n. sp. strongly flattened, lateral view.

Fig. 5. Longitudinal section of *Aerobiotrema muraenesocis* through terminal genitalia.

Fig. 6. Transverse section of *Aerobiotrema muraenesocis* through shell gland complex.

PLATE XV

Fig. 7. *Biovarium lateolabracis* n. sp., ventral view.

Fig. 8. *Prosorhynchus crucibulum japonicum* n. subsp., ventral view.

Fig. 9. *Diplopharyngotrema lateolabracis* n. g., n. sp., ventral view.

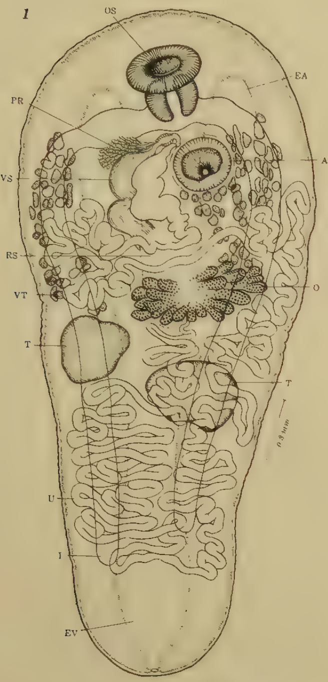
Fig. 10. Unflattened specimen of *Aerobiotrema muraenesocis*, free-hand sketch, ventral view.

Fig. 11. *Opecoelus sebastisci* n. sp.; forebody in lateral view, hindbody in ventral vew.

Fig. 12. *Opecoelus pagrosomi* n. sp., ventral view.

ABBREVIATIONS USED IN FIGURES

A=acetabulum, AN=anus, CP=cirrus pouch, EA=excretory arm, EP=excretory pore, EV=excretory vesicle, GA=genital atrium, GP=genital pore, I=intestine, LC=Laurer's canal, MO=mouth opening, O=ovary, OS=oral sucker, P=pharynx, PR=prostatic cell, R=rhynchus, RS=receptaculum seminis, SG=shell gland, T=testis, U=uterus, VR=Vitelline reservoir, VS=vesicula seminalis, VT=vitelline gland.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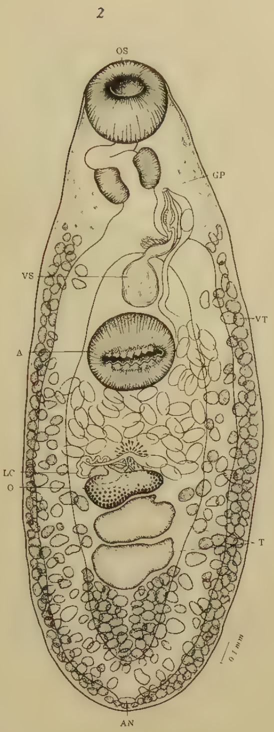
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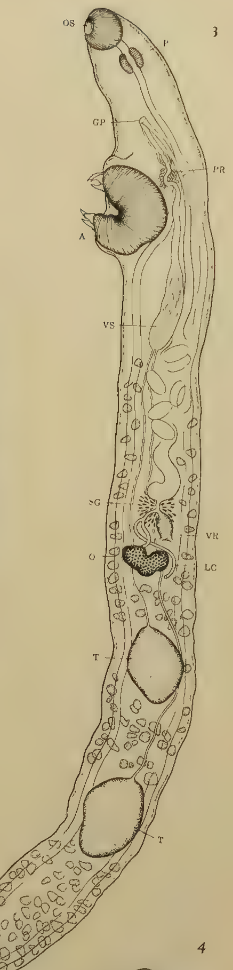
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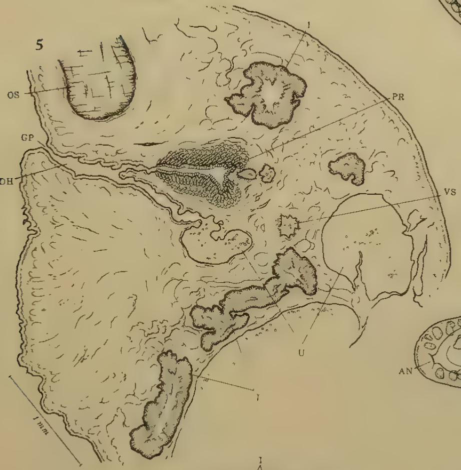
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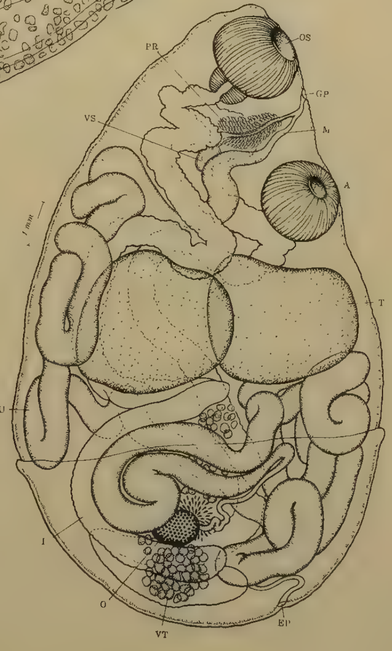
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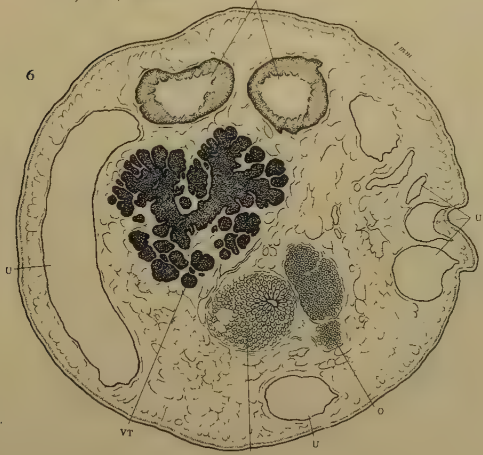
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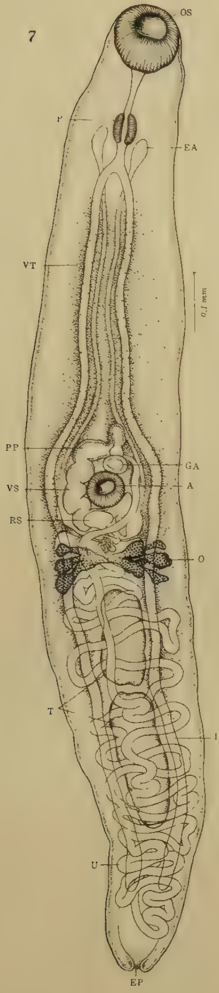
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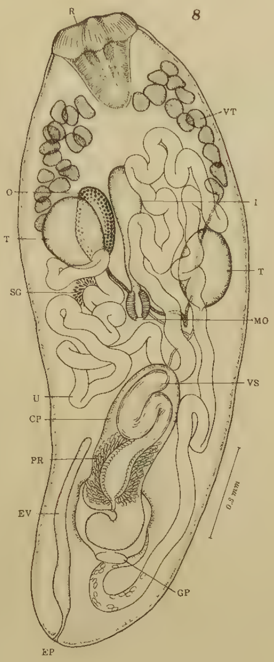
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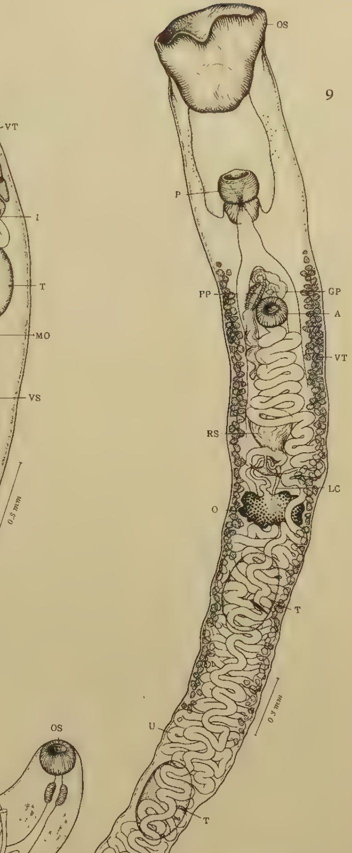
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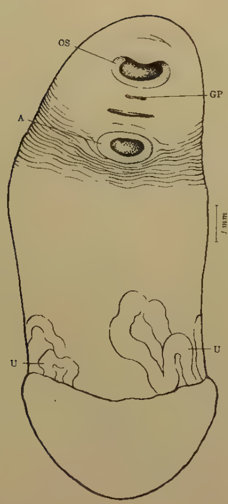
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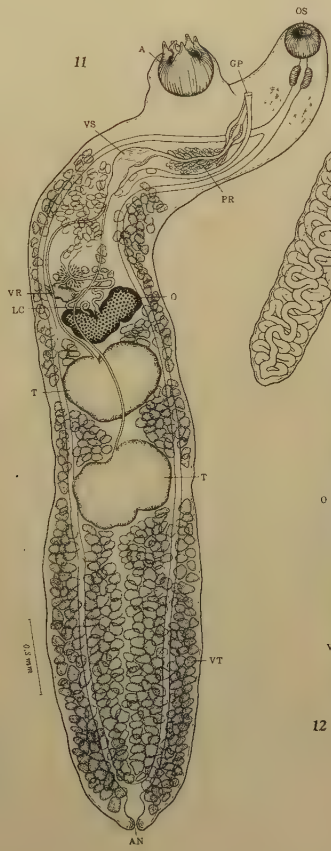
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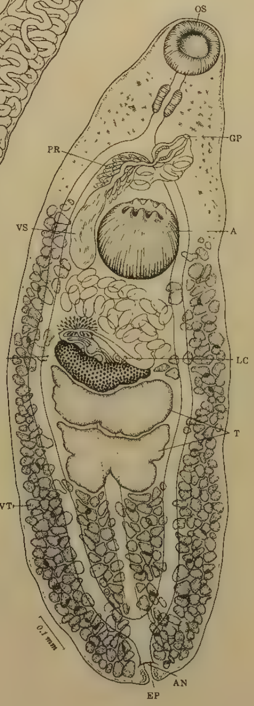
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A LIST OF BOTTOM ANIMALS COLLECTED BY A TRAWLER "KAIUN-MARU" OFF THE SOUTHWEST COAST OF KII PENINSULA[1]

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With 1 Text-figure

Introduction

We had an opportunity of examining bottom animals that were taken by the trawl-net on the continental shelf off the southwest coast of Kii Peninsula, to afford some aspects of their composition and distribution.

The fishing ground of trawlers of Minabe, Wakayama Prefecture, is extending on the continental shelf 2 miles or more off along the coast from Hino-Misaki southward to Susami. The main object of the fishery is the fish, *Taius tumifrons* (Temminck et Schlegel), with some others such as *Zeus japonicus* Cuvier et Valenciennes, *Upeneus bensasi* (Temminck et Schlegel), or *Hime japonica* (Günther). But also various kinds of bottom animal are caught together with these fishes, to which little attention is paid by these fishermen and which the junior author collected on board for the examination. The materials were obtained on November 28th and December 8th, 1957, although precise positions of collection were decided and recorded on the latter occasion only. Of five stations of collection on December 8th, four were westwards of Seto-zaki, their depths being from 120 to 150 metres approximately and their natures of the ground coarse sand, sand or fine sand. The other station, having a depth of 80 metres approximately, was westwards of the mouth of Tanabe Bay, somewhat nearer the coast than the former four stations, its nature of the ground being fine sand. On the first occasion (November 28th), the materials were taken mainly from the area around these former four stations.

The bottom animals thus collected, though only on two occasions, consist of 188 species belonging to 12 phyla, in which the fishes, mollusks and coelenterates were most abundant. The invertebrates were more abundant on deeper stations, especially the coelenterates on those of the coarse sandy or sandy bottom. *Endopachys japonicum* Yabe et Eguchi was found very abundantly at the deepest station (St. 4) of the

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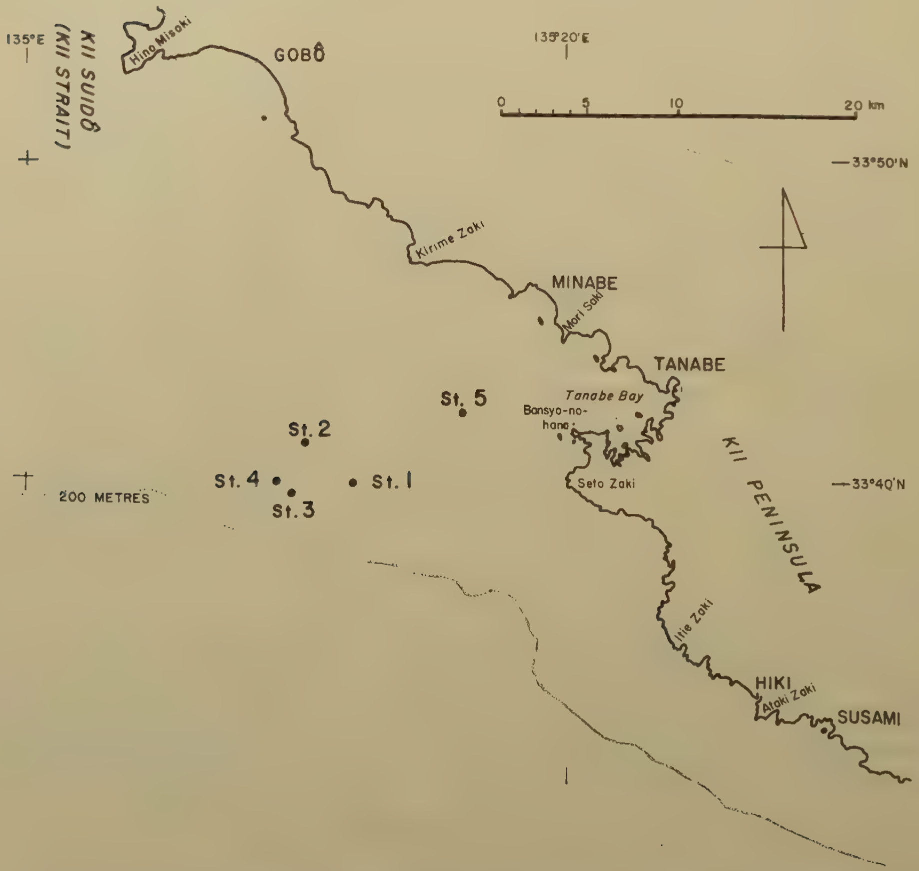
coarse sandy bottom exclusively. Of the mollusks, *Guildfordia triumphans* (PHILIPPI), *Xenophora pallidula* (REEVE) and *Apollon (Biplex) peca* (PERRY) were dominant all over deeper stations. With regard to the fish, there appears to be distinct difference between their compositions from deeper stations and from a shallower station.

Date	Station	Position		Approx. Depth (metre)	Substratum
		Long. (E)	Lat. (N)		
Nov. 28, 1957	Area neighbouring St. 1–4			80–150	fine-coarse sand
Dec. 8, 1957	1	135°12.2′	33°40.0′	120	fine sand
"	2	135°10.2′	33°41.1′	120	sand
"	3	135°09.7′	33°39.7′	140	sand
"	4	135°09.4′	33°40.0′	150	coarse sand
"	5	135°16.0′	33°42.2′	80	fine sand


135°E
KII SUIDÔ
(KII STRAIT)
Hino Misaki
GOBÔ
135°20'E
0
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20 km
33°50'N
Kirime Zaki
MINABE
Mori Saki
TANABE
Tanabe Bay
Bansyo-no-hana
St. 5
St. 2
St. 4
St. 1
St. 3
200 METRES
Seto Zaki
KII PENINSULA
33°40'N
Itie Zaki
HIKI
Ataki Zaki
SUSAMI

Fig. 1. Chart showing the positions of collection (●) by trawling on December 8th, 1957.

Acknowledgments

We wish to thank Mr. Ichiro YAGURA, Captain of the trawler "Kaiun-maru" and his crew for allowing us to make collection on board and affording facilities and help for it. Identifications of most of the invertebrates, though tentatively, were made by the senior author and those of fishes were made by the junior author. But Dr. Sadayoshi MIYAKE kindly identified the anomuran crustaceans and Dr. Itsuo KUBO the caridean crustaceans. Dr. Takasi TOKIOKA was also responsible for the tunicates and Mr. Torao YAMAMOTO was consulted for the mollusks. We are much obliged for these aids.

Phylum PROTOZOA

Class Rhizopoda

Order Foraminifera

Homotrema rubrum (LAMARCK) アカスナゴ	St. 1

Phylum PORIFERA

Class Hexactinellida

Euplectella oweni HERKLOTS et MARSHALL オウエンカイロウドウケツ	St. 2, 3, 4
?*Polylophus philippinensis* SCHULTZE	

Class Demospongiae

Stelleta sp.	
Gen. ? spec. ?	St. 2

Phylum COELENTERATA

Class Hydrozoa

Order Hydroida

Gonothyrea bicuspidata (CLARKE) フタエキザミ	St. 2
Clytia linearis THORNELY エダウミコツプ	
Symplectoscyphus tricuspidatus (ALDER) トゲウミシバ	
Amphisbetia furcata (TRASK) ヒメウミカビ	
Sertularella sp.	
Synthecium campylocarpum ALLMAN ツツウミシバ	
Gen. ? spec. ?	

Class Anthozoa

Subclass Alcyonaria

Order Stolonifera

Sarcodictyon gotoi (OKUBO) comb. nov.

Order Alcyonacea

Bellonella rigida Pütter ボウウミイチゴ	St. 1, 2, 3, 4
B. dofleini (Kükenthal) エダウミイチゴ	St. 1, 2, 3, 4
B. macrospina (Kükenthal) オオトゲウミイチゴ	St. 1, 2, 3, 4
Daniela koreni Koch	
Kochella studeri (Koch)	
Anthomastus granulosus Kükenthal エナガウミテングタケ（新称）	St. 1, 2, 3, 4
Minabea ozakii Utinomi ミナベトサカ	St. 2, 3, 4
Dendronephthya acaulis Kükenthal コデマリトゲトサカ	St. 1, 2, 3, 4, 5
Siphonogorgia dipsacea (Wright et Studer) アカバナクダヤギ	St. 2

Order Gorgonacea

Euplexaura ? *attenuata* (Nutting)	
Filigella mitsukurii Kinoshita イトヤギ（新称）	St. 1
Paramuriceidae (gen. ? spec. ?)	
Echinomuricea ? sp.	

Order Pennatulacea

Echinoptilum macintoshi Hubrecht トゲサボテン	
Funiculina quadrangularis (Pallas) ムチウミエラ	
Leioptilus fimbriatus (Herklots) ウミエラ	St. 1, 2, 4

Subclass Zoantharia

Order Actiniaria

? *Phyllactis striata* Wassilieff	
Actiniidae (gen. ? spec. ?)	St. 2, 4
Halcampella maxima R. Hertwig ナスビイソギンチヤク	St. 1, 4

Order Scleractinia

Flabellum pavoninum paripavoninum Alcock センスガイ	St. 2, 4
F. distinctum Milne Edwards et Haime	St. 1, 2, 4
F. rubrum (Quoy et Gaimard)	
F. deludens v. Marenzeller	
Stephanocyathus (*Odontocyathus*) *spiniger* (v. Marenzeller) コウロサンゴ（新称）	
Heterocyathus aequicostatus M. Edwards et Haime	
Bored by a commensal sipunculid, *Aspidosiphon* sp.	
Caryophyllia sp.	
Endopachys japonicum Yabe et Eguchi	St. 4
Dendrophyllia fistula (Alcock)	St. 2
D. arbuscula Van der Horst	St. 4

Balanophyllia gigas Moseley St. 2, 3, 4
Trochocyathus (*Thecocyathus*) *hanzawai* Yabe et Eguchi

Phylum ANNELIDA

Class Polychaeta

Order Polychaeta

Onuphis willemoesic (McIntosh) カナブツイソメ St. 1
Peculiar dwelling tube only.
??*Mesochaetopterus* sp. Dwelling tubes only.
Pomatostegus latiscapus Marenzeller St. 1, 3, 4
?*Hydroides norvegicus* (Gunnerus) カサネカンザシ
Lumbrineris latreilli (Audouin et Milne Edwards) ギボシイソメ St. 2
Stylarioides parmatus Grube
Glycera opisthobranchiata Marenzeller マイヅルチロリ
Dwelling tube of undet. Polychaeta St. 5

Order Myzostomida

Myzostomum ambiguum Graff ツノスイクチムシ

Phylum SIPUNCULOIDEA

Sipunculus nudus Linné スジホシムシ

Phylum ARTHROPODA

Class Pycnogonida

Ascorhynchus auchenicum (Slater) トゲトツクリウミグモ（新称）

Class Crustacea

Order Cirripedia

Balanus (*Chirona*) *tenuis* Hoek シロフジツボ（新称） St. 2
Sacculina sp.
Parasitic on a crab, *Actumnus squamosus*.

Order Isopoda

Gnathia sp.
Ianira chuni (Thielemann)

Order Amphipoda

Lilljeborgia brevicornis (Bruzelius)
Melita aff. *gladiosa* Bate

Maera sp.
Neopleustes boecki (Hansen)
Paramphithoe sp.
One sp. undet.

Order Decapoda

Suborder Natantia

Parapenaeus investigatoris Alcock et Anderson	St. 1, 2, 3
Parapandalus spinipes (Bate) オキノシラエビ	St. 1
Solenocera sp.	
Synalpheus sp.	
Plesionika sp.	
Spongicola venusta de Haan ドウケツエビ Lodged commensally in the gastral cavity of a sponge, *Euplectella oweni.*	St. 2, 3, 4

Suborder Reptantia

Tribe Palinura

Ibacus ciliatus (von Siebold) ウチワエビ	St. 1, 2, 3

Tribe Anomura

Dardanus arrosor (Herbst) ヨコミゾヤドカリ	St. 1, 2, 3, 4
Pagurus ophthalmicus (Ortmann)	
Pagurus sp.	
Paguristes palythophilius Ortmann	St. 1, 2
Parapagurus diogenes (Whitelegge)	
Galathea pubescens Stimpson ケブカガラテア	
G. subsquamata Stimpson	
G. elegans White コマチガラテア	
Uroptychus scandens Benedict トゲエビモドキ Lodged commensally in the ventral groove of a sea-pen, *Leioptilus fimbriatus.*	St. 1, 2, 4
Munida japonica japonica Stimpson ヤマトムニダ	
Cervimunida princeps Benedict ツノガムニダ	St. 2

Tribe Brachyura

Homola orientalis Henderson トウヨウホモラ	
Latreillia phalangium de Haan ミズヒキガニ	St. 2, 3, 4
Latreillopsis bispinosa Henderson トゲミズヒキガニ	St. 4
Pleistacantha sancti-johannis Miers ハリセンボン	St. 3
Leptomithrax edwardsi (de Haan) コシマガニ	St. 1, 2

Charybdis bimaculata (MIERS) フタホシイシガニ	
C. miles DE HAAN アカイシガニ	St. 5
Actumnus squamosus DE HAAN イボテガニ	
Some specimens carry *Sacculina* sp.	St. 1, 2, 3, 4

Phylum MOLLUSCA

Class Pelecypoda

Order Anisomyaria

**Pecten* (*Notovola*) *albicans* (SCHRÖTER) イタヤガイ	
Cryptopecten vesiculosus (DUNKER) ヒヨクガイ	St. 4
Ostrea sp.	
**Meiocardia tetragona* (ADAMS et REEVE) コウホネガイ	

Order Eulamellibranchia

Clavagella (*Stirpulina*) *ramosa* DUNKER ハマユウ

Class Gastropoda

Order Archaeogastropoda

Calliostoma (*Tristichotrochus*) *aculeatum* SOWERBY トゲエビス	St. 4
C. haliarchus (MELVILL) ヒラコマ	St. 1
Guildfordia triumphans (PHILIPPI) リンボウガイ	St. 1, 2, 3, 4

Order Mesogastropoda

Architectonica maxima (PHILIPPI) クルマガイ	
*?*Siliquaria* sp.	St. 1, 2, 3
Vermiculariidae (gen. ? spec. ?)	
**Onustus exutus* (REEVE) キヌガサガイ	
Xenophora pallidula (REEVE) クマサカガイ	St. 1, 2, 3, 4
Neverita (*Glossaulax*) *didyma* (RÖDING) ツメタガイ	
**Semicassis japonica* (REEVE) ウネウラシマ	
Apollon (*Biplex*) *peca* (PERRY) マツカワガイ	St. 1, 2, 3, 4
Tritonalia sauliae (REEVE) ボウシュウボラ	St. 1
**Bursa* (*Bufonariella*) *ranellvides* (REEVE) コナルトボラ	

Order Neogastropoda

Murex (*Siratus*) *pliciferoides* KURODA ハツキガイ	St. 1, 2
Ceratostoma (*Ocenebra*) *eurypteron* (ADAMS et REEVE) ヨウラクヒレガイ	
Latiaxis (*Tolema*) *japonicus* (DUNKER) テンニヨノカムリ	St. 2
L. pagodus (A. ADAMS) ヒメカセン	St. 4

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* Dead shells only.

Fusinus simplex (SMITH) シロヒメナガニシ	St. 1, 2
**F. forceps* (PERRY) イトマキナガニシ	
**Granulifusus niponicus* (SMITH) アラレナガニシ	
Gemmula granosa (HELBLING) ジュズカケクダマキ	St. 1
**Nassarius* (*Zeuxis*) *caelatus* (A. ADAMS) ハナムシロ	
**Asprella* (*Endemoconus*) *sieboldi* (REEVE) アコメガイ	
A. (*Conasprella*) *cancellata* (BRUGUIÈRE) ヒシイモガイ	

Order Nudibranchia

Nudibranchia (gen. ? spec. ?)

Class Cephalopoda

Order Decapoda

Sepia (*Sepia*) *esculenta* HOYLE コウイカ	St. 1, 2, 3, 4

Phylum BRYOZOA

Order Cheilostomata

Adeona japonica (ORTMANN) ツノコケムシ

Phylum BRACHIOPODA

Order Telotremata

Laqueus rubellus (SOWERBY) ホウズキチヨウチン

Phylum ECHINODERMATA

Class Crinoidea

Order Articulata

Comantheria grandicalyx (CARPENTER) オオバンウミシダ	St. 3, 4
Comatulida (gen. ? spec. ?)	St. 4

Class Asteroidea

Order Phanerozonia

Ctenopleura ludwigi (DE LORIOL)	
Luidia maculata MÜLLER et TROSCHEL ヤツデスナヒトデ	St. 2
Pteraster tesselatus IVES	St. 1

Order Spinulosa

Henricia pachyderma HAYASHI	
Hymenaster glaucus SLADEN マクヒトデ	St. 4

Class Ophiuroidea

Order Euryalae

Gorgonocephalus sp.

Order Ophiurae

Stegophiura sp.
2 other spp. undet.

Class Echinoidea

Order Cidaroidea

Stereocidaris grandis (DÖDERLEIN) フトザオウニ	St. 1, 4
Goniocidaris (*Petalocidaris*) *biserialis* (DÖDERLEIN) トゲザオウニ	St. 1, 4

Order Camarodonta

Temnopleurus (*Toreumatica*) *apodus* (A. AGASSIZ et H. L. CLARK) コツブサンショウウニ	
Chaetodiadema japonicum MORTENSEN ヤワラガゼ	St. 1, 4

Order Clypeastroida

Clypeaster virescens DÖDERLEIN オオタコノマクラ	St. 3

Class Holothurioidea

Order Aspidochirota

Stichopus sp.	St. 1, 4
Holothuria sp.	St. 3

Phylum PROCHORDATA

Class Urochordata

Subclass Ascidiacea

?*Syndiazona grandis* OKA, juv. ボウズボヤ	St. 1
Homoeodistoma longigona TOKIOKA (MS.)	St. 1

Subclass Pyrosomata

Pyrosoma spinosum (HERDMAN)	St. 1
P. atlanticum atlanticum PÉRON ヒカリボヤ	St. 1

Phylum VERTEBRATA

Class Chondrichthyes

Order Lamnida

Mustelus griseus PIETSCHMANN シロザメ	St. 1, 4

Order Rajida

Rhinobatus schlegeli Müller et Henle サカタザメ	
Raja kenojei Müller et Henle ガンギエイ	St. 4
Dasyatis akajei (Müller et Henle) アカエイ	St. 3, 5

Class Osteichthyes

Order Myctophida

Hime japonica (Günther) ヒメ	St. 1, 2, 3, 5
Saurida undosquamis (Richardson) マエソ	St. 3, 4
Synodontidae (gen. ? spec. ?)	St. 1, 2, 3, 4

Order Anguillida

Muraenesox cinereus (Forskål) ハモ	St. 1, 2, 3

Order Syngnathida

Fistularia villosa Klunzinger アオヤガラ	

Order Berycida

Monocentris japonicus (Houttuyn) マツカサウオ	

Order Zeida

Zeus japonicus Cuvier et Valenciennes	St. 1, 2, 3, 4

Order Percida

?*Sphyraena pinguis* Günther アカカマス	
Trachurus japonicus (Temminck et Schlegel) マアジ	St. 1, 2
Caranx equula Temminck et Schlegel カイワリ	St. 5
Leiognathus rivulatus (Temminck et Schlegel) オキヒイラギ	St. 5
Upeneus bensasi (Temminck et Schlegel) ヒメジ	St. 1, 2, 3, 4, 5
Branchiostegus japonicus japonicus (Houttuyn) アカアマダイ	St. 1, 3, 5
Apogon kiensis Jordan et Snyder テツボウイシモチ	St. 5
Pseudopriacanthus niphonius (Cuvier) クルマダイ	St. 1, 2, 3, 4
Acropoma japonicum Günther ホタルジヤコ	St. 5
Epinephelus septemfasciatus (Thunberg) マハタ	St. 4
Nemipterus bathybus Snyder ソコイトヨリ	St. 5
Taius tumifrons (Temminck et Schlegel) キダイ	St. 1, 2, 3, 4
Scolopsis inerme (Temminck et Schlegel) タマガシラ	St. 5
Neopercis sexfasciata (Temminck et Schlegel) クラカケトラギス	St. 1, 2, 3, 4, 5
N. multifasciata (Döderlein) オキトラギス	St. 1, 2, 3, 4
Uranoscopus japonicus Houttuyn ミシマオコゼ	St. 1
Calliurichthys japonicus (Houttuyn) ヨメゴチ	St. 1, 2, 3, 4

Microcanthus strigatus (Cuvier et Valenciennes) カゴカキダイ	St. 5
Antigonia rubescens (Günther) ベニヒシダイ	St. 1, 2, 3, 4

Order Cottida

Scorpaena izensis Jordan et Starks イズカサゴ	St. 1, 2, 3, 4
Pterois lunulata Temminck et Schlegel ミノカサゴ	St. 2
Scorpaenidae (gen.? spec.?)	St. 3
Inimicus japonicus (Cuvier et Valenciennes) オニオコゼ	
?*Lepidotrigla abyssalis* Jordan et Starks ソコカナガシラ	St. 1, 2, 3, 4
?*L. japonica* (Bleeker) トゲカナガシラ	St. 1, 2, 3, 4

Order Tetraodontida

Kentrocapros aculeatus (Houttuyn) イトマキフグ	St. 1, 2, 3

Order Pleuronectida

Bothidae (gen.? spec.?)	St. 1, 2, 3, 4, 5
Pleuronichthys cornutus (Temminck et Schlegel) メイタガレイ	St. 1, 2, 5

Order Lophiida

Lophiomus setigerus (Vahl) アンコウ	St. 1
Antennarius laterallis Tanaka オオモンイザリウオ	St. 1
Halieutaea stellata (Vahl) アカグツ	St. 2